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Long-term psychosocial outcome after severe closed head injury: A controlled study.

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Long-term Psychosocial Outcome after Severe Closed Head Injury: A Controlled Study

by

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ABSTRACT

Psychosocial functioning was examined in 57 severely head injured patients at least two years after the termination of post-traumatic amnesia. A group of 50 nonbrain-damaged spinal cord injured patients matched on age, education, sex, premorbid socioeconomic status, and marital status served as controls. Results on the Katz Adjustment Scale - Relative's Form indicated that only some of the difficulties commonly reported after closed head injury are more frequent with head injury than with spinal cord injury. Results on the Psychosocial Adjustment to Illness Scale - Self-Report form suggested that the head injured patients minimized many of their difficulties. Head injured patients showed a greater drop in pre- to post-injury socioeconomic status than did spinal cord injured patients. Premorbid education and injury severity were associated with post-injury socioeconomic status in both groups. The results suggest that long-term outcome after severe closed head injury is not only correlated with severity of brain injury. Factors such as premorbid characteristics and the presence of a chronic disability may also be important. However, brain injury appears to exacerbate certain difficulties beyond the point that they are experienced by other chronically disabled individuals.

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CHAPTER I

INTRODUCTION

Head injury is one of the most common causes of disability, especially among young adults. Estimates of the incidence of head injury range from 170 to 600 cases per 100,000 per year, depending on inclusion criteria (Levin, Benton, & Grossman, 1982). Because of advances in the medical management of head trauma, severely injured individuals who only a few decades ago would have died of their injuries are now surviving. These individuals show little or no decrease in life expectancy (Cartlidge & Shaw, 1981; Lewin, Marshall, & Roberts, 1979). As such, quality of life issues have become vitally important.

The ability to cope with the demands of work, leisure activities, social activities, family, and marital relationships after head injury has been termed social (or psychosocial) outcome (Oddy, 1984). Several recent studies (e.g., Brooks, Campsie, Symington, Beattie, & McKinlay, 1986; Thomsen, 1985) have examined both predictors and the extent of psychosocial outcome following severe head injury. However, few studies have utilized a control group (McKinlay & Brooks, 1984).

Consequently, the extent to which psychosocial disability after closed head injury (CHI) is due to specific effects of the head injury as opposed to general (nonbrain-related) impairment found with any chronic disabling condition remains largely undetermined.

Spinal cord injured patients have been proposed as good controls for severely head injured patients in psychosocial outcome studies (McKinlay & Brooks, 1984). This is because both groups of patients tend to share several demographic and injury-related characteristics. For example, they are disproportionately young, male, and must endure chronic disability. (Davidoff, Thomas, Johnson, Berent, Dijkers, & Doljanac, 1988; Kalsbeek, McLaurin, Harris, & Miller, 1980; Rimel, 1981). Given that the two groups tend to be injured in similar mishaps (e.g., motor vehicle accidents and falls: Davidoff et al., 1988; Rimel, 1981) chance factors would seem to play an overwhelming role in determining whether a CHI or spinal cord injury (SCI) is suffered by a particular individual (Stambrook, Moore, Peters, Zubek, & MacBeath, 1989).

The only published study that has utilized a control group of SCI individuals to evaluate psychosocial outcome after brain injury (Rosenbaum & Najenson, 1976) used Israeli war veterans. However, war veterans are not representative of civilians who suffer spinal cord and/or severe head injuries, as veterans are often much more financially secure than civilians are post-injury (Rosenbaum & Najenson, 1976; Trieschman, 1980). In addition veterans often suffer wounds that penetrate the meninges surrounding the brain whereas most civilian injuries are due to closed head trauma (Davidoff, Thomas, Johnson, Berent, Dijkers, & Doljanac, 1988). Finally, war veterans (if draftees) presumably constitute a representative cross-section of healthy young males. In contrast, civilians who suffer CHI are disproportionately likely to have histories of alcohol abuse and other "predisposing" characteristics that are not representative of the general population (Rimel, 1981).

The present study will examine predictors, and the extent, of psychosocial outcome after severe CHI. A group of SCI patients will serve as controls in an attempt to dissociate the extent to which psychosocial disability after CHI is due to brain injury as opposed to non-brain related factors associated with other chronic disabling conditions. The present study will thus only include SCI patients who did not suffer a concomitant CHI. Because approximately 50% of SCI victims also suffer CHI (Davidoff et al., 1988), this is a vital consideration. Very few studies of SCI have explicitly screened for CHI in their SCI patients. Consequently, it seems reasonable to assume that many SCI patients in previously published studies have also suffered a CHI. Therefore, the findings of such SCI studies may be confounded by brain-related disabilities. By explicitly addressing this issue, the present study will also make a contribution to the SCI psychosocial outcome literature.

All SCI and CHI patients in the present study will be at least two years post-injury to allow examination of long-term outcome. Two years has been found by many researchers (e.g., Alfred, Fuhrer, & Rossi, 1987; Miller & Stern, 1965; Oddy, Coughlan, Tyerman, & Jenkins, 1985; Webb, Lorenzi, & Berzins, 1982) to be a time after which psychosocial recovery tends to plateau.

The literature review which follows is divided into two main sections, one on CHI and one on SCI. Each section will examine pathophysiology and other factors associated with the injury, followed by a review of long-term psychosocial outcome literature (i.e., that with a followup of at least two years post-injury). After this, a brief section will review the limited research that has directly or indirectly compared SCI and CHI. A final, concluding section integrates and summarizes the research that has been reviewed.

Pathophysiology of Closed Head Injury and Measures of Severity

This section consists of two parts. First, a brief review of the mechanisms and pathophysiology of closed head injury is presented. The second subsection is a brief review of some indicators that are used to gauge the severity of head injury.

Pathophysiology. The two major types of head injury differentiated in the literature are open and closed head injury (Levin et al, 1982). Open head injury occurs when the dura mater is penetrated. Closed head injury is an injury in which the meninges are not penetrated (Gilroy & Holliday, 1982). A closed head injury may be classified as either acceleration or a deceleration injury (Reitan & Wolfson, 1985a). An acceleration injury occurs when a fast moving object strikes a stationary head. A blow to the head with a blunt instrument is one example of an acceleration injury. A deceleration injury occurs when a moving head hits a stationary object. A head striking the windshield of a car that has come to a sudden stop is an example of a deceleration injury.

Levin et al. (1982) outlined general types of brain damage that may result after closed head injury. Primary effects are those types of damage that occur on impact.

They include macroscopic lesions such as coup and contrecoup contusions, as well as microscopic lesions such as the extensive stretching and shearing of nerve fibres (Adams, Mitchell, Graham, & Doyle, 1977). Secondary mechanisms, which may shortly follow primary effects, include intracranial hemorrhage, edema, ischemia, and increased intracranial pressure (Adams et al., 1977). Finally, delayed effects such as white matter degradation and disruption of cerebrospinal fluid flow (hydrocephalus) may cause impairment. Primary and secondary mechanisms are now considered in greater detail.

Primary effects of closed head injury are those which occur on impact. In non-trivial head injury the skull is temporarily bent inward and the brain rotates inside the skull because of the force of the blow. Coup contusion (bruising) results from the force at the area of impact. Contrecoup contusion describes distal damage that may result from relative movement of the brain during impact or from cavitation effects caused by negative pressure (Gurdjian & Gurdjian, 1976). Coup damage may occur after a blow anywhere to the head. On the other hand, contrecoup lesions are far less likely to occur in occipital than in fronto-temporal regions (Gurdjian & Gurdjian, 1976). This is because the skull cavity is relatively smooth in the posterior fossa whereas the anterior and middle fossae have many bony protuberances. In addition, the tissue in the fronto-temporal areas is of more varied density making it more susceptible to contusion when the force of the blow displaces tissue (Ommaya & Gennarelli, 1974). Contusions do not only affect the cerebral hemispheres; the brainstem is also often affected (Adams et al., 1977).

Of the primary effects of closed head injury, though, coup and contrecoup contusion are not the most pervasive. Rather, the stretching and shearing of nerve fibres upon impact appear to be the most common of the primary effects (Strich, 1961). In the preponderance of cases, contusive injuries are superimposed on this diffuse fibre damage. Rotation of the brain and brainstem after a forceful blow to the head has been implicated as the primary mechanism in the diffuse shearing of fibres (Strich, 1961). The frontal and temporal lobes are especially susceptible to this type of fibre damage due to the bony irregularities of the anterior and middle cranial fossae and variation in tissue density in these areas (Ommaya & Gennarelli, 1974).

Stretching and shearing of brainstem reticular fibres and structures are assumed to be the immediate causes of loss of consciousness (Gurdjian, 1975, pp. 215-216). However, such damage rarely occurs without concomitant damage to the fibres in the cerebral hemispheres (Ommaya & Gennarelli, 1974). The realization that this widespread stretching and shearing of nerve fibres is extremely common after closed head injury has come about only after microscopic post-mortem examinations of the brain (Adams et al., 1977; Oppenheimer, 1968; Strich, 1961). Although CT scans do not detect such microscopic damage, new generation scanners such as magnetic resonance imagers appear to be more sensitive to such lesions (Levin, Kalisky, Handel, Goldman, Eisenberg, Morrison, & Laufen, 1985).

Secondary effects of head injury are those which result from the physiological processes occurring after primary injury. Intracerebral, subarachnoid, subdural, or epidural hematomas are the primary causes of focal secondary damage (Levin et al., 1982). Hematoma arises as a result of blood vessels being torn. Depending on the location of the collection of blood, damage may be due to direct contact of blood with brain tissue, to pressure effects of the expanding mass, or to both. Adherence of clotted blood to arteries in the subarachnoid space may lead to vasospasm and subsequent ischemic damage (Kassell, Boarini, & Adams, 1982).

Cerebral edema, which may produce focal or diffuse effects depending on its pervasiveness, is often found in the area of hemorrhage or contusion (Strich, 1969). Edema contributes to expanding mass effects, but it is unclear whether edema damages the brain directly (Levin et al., 1982). It is interesting to note that the edema associated with hemorrhage occurs disproportionately in the fronto-temporal areas, as does the edema associated with primary effects.

Increased intracranial pressure is often associated with intracranial hematoma and edema (Strich, 1969). The increase in intracranial pressure reduces cerebral perfusion pressure, which in turn reduces blood flow (Marshall & Bowers, 1982). Diffuse ischemic damage may eventuate as a result of these mechanisms (Levin et al., 1982). The hippocampus and basal ganglia may be particularly susceptible to such ischemia, especially with severe injury (Van Zomeren, 1981).

In summary, tissue damage associated with head injury is rarely only of a focal nature. Rather, focal lesions such as contusions and hematomas are usually superimposed on widespread microscopic white matter damage. To the extent that focal lesions do occur they are most likely to be in the temporal and orbito-frontal areas. This is due to the structural irregularities of the anterior and middle cranial fossae. Ischemic damage, although often widespread, may especially affect areas such as the hippocampi (located in the temporal lobes). Possible delayed effects (not elaborated upon here), such as hydrocephalus and degeneration of cerebral white matter, may also combine and interact with aforementioned pathophysiology to produce a variety of outcomes. However, widespread or diffuse damage with the possibility of more severe focal lesions in the fronto-temporal areas is most characteristic of the pathophysiology of non-trivial closed head injury.

Measures of head injury severity. There are three commonly reported measures of the severity of head injury. These are (a) length of coma, (b) Glasgow Coma Scale score, and (c) duration of post-traumatic amnesia.

Length of coma has been variously defined in the literature. Depending on the investigator, termination of coma has been said to occur anytime from the onset of eye opening (Jennet & Teasdale, 1981) to onset of the ability to establish intellectual contact with the environment (Stover & Zeiger, 1976). Regardless of the validity of any particular measure of coma duration, the lack of reliability across observers and the lack of consistency in definition across studies often makes research findings difficult to compare. Other problems with the use of coma duration as a measure of injury severity are that (a) coma has many gradations, making simple classification almost impossible (Stover & Zeiger, 1976) and (b) patients may be maintained in coma for medical reasons by the administration of barbiturates. Duration of coma as a measure of severity is relatively meaningless in the latter case.

The Glasgow Coma Scale (GCS; Jennett & Teasdale, 1981) was developed largely in response to the unreliability of coma assessment by different observers. The GCS consists of three subscales assessing eye opening, best motor response, and best verbal response. Responses are scored on 4, 6, and 5 point scales, respectively. A score of one point on each scale, for a total of three points, is the most impaired score obtainable, whereas a total summed score of 15 is indicative of optimal function. Standard instructions are used so as to maximize reliability across observers. The GCS has gained widespread acceptance as a measure of injury severity (Myers, Levin, Eisenberg, & Guinto, 1983; Tabbador, Mattis, & Zazula, 1984). However, induction of barbiturate coma, existence of peripheral injuries, indwelling tracheotomy tubes, and language deficits are but four factors that may limit the utility of the GCS as a measure of injury severity.

Duration of post-traumatic amnesia (PTA) has also been used as an indicator of the severity of head injury. PTA is said to have ceased when continuous anterograde memory for events has returned (Russell, 1932). Specifically, Russell's original formulation defined PTA as the time from injury to the time at which the patient recalled having continuous anterograde memory. Such a definition may produce notoriously unreliable and invalid data because of personal biases and a host of other contaminating variables (Stover & Zieger, 1976). An alternate method to assess PTA involves the daily questioning or the formal testing of the patient for events in the patient's environment. This strategy has the potential to be more reliable and valid than Russell's procedure. It is nevertheless subject to variability dependent on such factors as the extent of questioning. Results may also be affected by conditions that affect the patient's ability to respond (e.g., aphasia), but that are independent of memory function per se.

It is apparent that the three most commonly used measures of severity of head injury each have their limitations. However, Jennett and Teasdale's (1981) expanded version of Russell's (1932) system has recently become a commonly used index of injury severity. The classification is based on duration of PTA or time from injury to return of continuous anterograde memory. It is as follows:

Very mild: less than 5 minutes
Mild: 5 to 60 minutes
Moderate: 1 to 24 hours
Severe: 1 to 7 days
Very severe: 1 to 4 weeks
Extremely severe: more than 4 weeks

Although length of coma, Glasgow Coma Scale scores, and length of PTA are three of the most commonly used indicators of severity of injury, other indicators have also been used to assess functioning after head injury. These include neuropsychological indices such as the Halstead Impairment Index (HII) and the Average Impairment Rating. The HII (cf. Halstead, 1947) is actually a consistency-of-impairment index that is derived from a patient's performance on 10 neuropsychological tests found to discriminate between groups of normal and brain damaged subjects. Based on cutoff points, performance on each test is classified as indicative or nonindicative of brain damage. A performance in the brain damaged range on any given test adds .1 to the index. The most impaired score possible is 1.0, based on impaired performance on all tests. A HII score of .5 or greater or greater is considered indicative of brain damage. The HII has subsequently been modified by Reitan (Reitan & Wolfson, 1985b) to include only the seven tests shown to most reliably discriminate between groups of brain damaged and nonbrain damaged subjects.

The Average Impairment Rating (AIR) was developed by Rennick (Russell, Neuringer, & Goldstein, 1970). The AIR for a patient's performance is derived from many of the same tests used to derive the HII, plus some additional measures. Other than including some additional neuropsychological measures, the major difference between the HII and the AIR is that the latter classifies performance on each test into one of five grades (zero to four). A score of zero is assigned if performance is more than one standard deviation above the mean of a normal control group and a score of one is assigned if performance is within the range of plus or minus one standard deviation of the control group. Performances more than one, two, or three standard deviations below the mean of the control group are assigned scores of two, three, and four, respectively. The overall AIR is then obtained by finding the average of the AIR scores across relevant measures. The major advantage of the AIR is that it allows evaluation of the degree of severity of brain damage, as opposed to a simple dichotomous classification of brain-damaged versus nonbrain damaged performance (Russell et al., 1970).

In conclusion the AIR has several advantages over more conventional indices of injury severity, such as length of coma, GCS scores, and duration of PTA. One advantage is that the AIR represents a finer-grained, quantified assessment of the degree of impairment present in skills necessary for daily functioning. Also, because the AIR is obtained after the return of consciousness, factors such as barbiturate coma that render other measures meaningless are not contaminants. The more conventional indices of severity of injury are much cruder measures of skills necessary for daily functioning, if they can be considered that at all. Rather, the more conventional measures may be good indicators and predictors of low-level functioning in a patient who is in coma or who has recently emerged from coma. The value of conventional measures is somewhat limited once a patient has progressed beyond a grossly impaired state.

Long-term Psychosocial Outcome after Severe Closed Head Injury

For the purposes of the present study and generally consistent with previous research, psychosocial outcome is defined as the degree to which emotional, interpersonal, and vocational functioning has returned to "normal." In the case of CHI, normal is most reasonably defined as an individual's pre-injury functioning. Unfortunately, reliable premorbid indicators of functioning are often not available, or are available for only some areas (e.g., occupational status). Thus the psychosocial outcome of individuals in CHI outcome studies have been judged on subjective bases, compared to normative data or, less frequently, compared to control groups.

The sections that follow focus on two major areas: vocational and emotional/interpersonal functioning two or more years after CHI.

Vocational outcome. There are at least three methodological issues that must be addressed before a review of the literature is presented. The first issue relates to overestimation of the proportion of severe CHI individuals who return to work. For example, Gutterman and Shenkin (1970) reported that 8 of 12 of their severe CHI patients over the age of 20 returned to work. Careful inspection of their data, though, showed that only 29 of their original group of 52 severe CHI cases even survived. Thus return to work estimates in most CHI studies involve return to work of survivors of CHI, who also chose to participate in the research (raising the possibility of volunteer bias).

A second methodological issue of note is that two years often seems to be a point by which relative stability in work status is achieved. For example, Oddy et al. (1985) reported that vocational status in their group of patients had not changed from two to seven years post-injury.

A final methodological issue involves stability of work status. Weddell et al. (1980) found that there was much changing of occupations during the first two years post-injury. Studies that report employment/unemployment rates at one point in time soon after injury may be misleading.

The general conclusion that one may draw from even a cursory review of the literature is that most individuals who suffer very severe CHI (i.e. PTA of more than 7 days) do not return to the same occupational level that they held premorbidly. Less well delineated are the predictors of individual's and group's return to work.

The rate of return to former levels of employment after very severe CHI is low, with estimates ranging from 5% or lower (Lewin et al., 1979; Rimel, 1981) to 28% (Ackerlund, 1959). The rate of return for any length of time to any level of gainful employment ranges from 7.5% (Thomsen, 1984) to 54% (Weddell et al., 1980). The rate of return to work for those with less than very severe injuries is generally better, ranging from 64% (Bruckner & Randle, 1972) to 97% (Steadman & Graham, 1969).

As implied by these data, the rate of return to work is correlated with severity of CHI (e.g., Adey, 1963; Bond, 1976; Gilchrist and Wilkinson, 1979; Van Zomeren & Van Den Berg, 1985). However, given that severity of injury only accounts for a minority of variance in return to work measures, other variables are also important. These are considered next.

The two primary correlates of return to work are mental/behavioral and physical status post-injury (Weddell et al., 1980). Of the two, mental/behavioral changes have been generally more strongly related to return to work (e.g., Bond, 1976; Gilchrist & Wilkinson, 1979; Lewin et al., 1979). The two most commonly cited mental/behavioral factors limiting return to work are: (1) poor memory (Prigatano et al., 1984; Van Zomeren & Van Den Berg, 1985; Weddell et al., 1980) and (2) "personality problems" such as irritability and impulsivity (e.g., Bruckner & Randle, 1972; Gilchrist & Wilkinson, 1979; Stambrook et al., 1988; Weddell et al., 1980). Other mental/behavioral factors that have been cited include: (1) lower scores on "IQ" tests (Weddell et al., 1980); (2) slowness (Van Zomeren & Van Den Berg, 1985); (3) inability to perform two tasks at once (Van Zomeren & Van Den Berg, 1985): (4) "denial" of disability (Weinstein & Lyerly, 1968); (5) dysphasia (Bruckner & Randle, 1972); and (6) premorbid characteristics, such as alcoholism (Gjone et al., 1972). This myriad of correlates of return to work is best put into perspective by Prigatano et al. (1984) who stated that good neuropsychological skills are necessary but not sufficient for return to work. Job training and other practical skills are vital, especially given the difficulty that severely brain injured individuals have generalizing skills from one context to another (Schacter, 1988).

Although generally found to be of lesser importance, physical factors such as hemiplegia (Bruckner & Randle, 1972) and neurological signs (Gilchrist & Wilkinson, 1979; Weddell et al., 1980) are somewhat correlated with return to work. The only study to date that has found physical factors to be more strongly related than mental/behavioral factors to return to work (Klonoff, Costa, & Snow, 1986) differed from most other studies in at least two respects. First, Klonoff et al. used fine grained neuropsychological measures of motor functioning, not coarse neurological parameters (e.g., cranial nerve signs). Second, their sample consisted primarily of mild

CHI patients. Their patients' cognitive impairments may have been milder than those found in other studies and thus had relatively less bearing on return to work. In addition, the use of fine grained neuropsychological motor measures rather than more gross neurological signs may have increased the variance available for statistical analyses.

Predictors receiving mixed support vis-a-vis return to work include age and social class. Although younger persons (i.e., those less than 40 years old) have generally been found to be able to return to work at a greater rate than have older persons (Bruckner & Randle, 1972; Heiskanen & Sipponen, 1970; Lundholm et al., 1985), there are some exceptions to this finding (e.g., Weddell et al., 1980). A possible explanation for Weddell et al.'s findings was that the age variance in their sample was quite restricted. The mean age was 24.6 years and the standard deviation was 6.2 years.

The mixed findings on the issue of social class (e.g., Gjone et al., 1972 versus Weddell et al., 1980) have several possible explanations. First, if the injury is severe enough to preclude return to work, the question is academic regardless of social class. Second, one's answer depends on the sample characteristics. If one includes chronic alcoholics who had a spotty employment history premorbidly (e.g., Gjone et al., 1972), then "social class" is more likely to be a factor than if the sample excludes such individuals.

To summarize, most patients with very severe CHI do not return to the same employment that was held pre-injury, if they return to work at all. Return to work is correlated with injury severity. Most studies have also indicated that younger individuals are more likely to return to work than are older ones. Mental/behavioral (especially memory and personality) changes tend to be more predictive of return to work than is physical status. Neuropsychological skills are necessary, but not sufficient for return to work; job training and practical skills are also vital.

Glasgow Outcome Scale studies. The Glasgow Outcome Scale (GOS) was developed to quantify quality of life outcomes, and to go beyond the simple categories "death" versus "survival" (Jennet & Bond, 1975). Survival may be a good outcome from a neurosurgeon's perspective, but patients and their families are more likely to judge outcome vis-a-vis premorbid quality of life (Jennett & Bond, 1975).

The GOS (Jennet & Bond, 1985) is divided into 5 categories: (1) death; (2) persistent vegetative state, where the patient remains unresponsive for weeks to months until the time of death; (3) severe disability, where the patient is dependent on others for self-care and most other activities; (4) moderate disability, where the patient can travel by public transport and work in a sheltered environment; and (5) good recovery, where there is a resumption of "normal life," even though there may be "minor" neurological or psychological deficits. In addition, return to work need not necessarily be obtained.

It is evident that despite the commendable quantification of outcome by the GOS, the GOS is still too coarse a measure to adequately reflect the subtleties of psychosocial outcome. For example, it is unlikely that most families would consider their loved one to have a good outcome if he or she were unable to return to work because of what a health professional deemed a "minor" psychological deficit. This position is indirectly supported by the creators of the GOS who indicate that quality of life for the patient and his family is likely to be judged against premorbid functioning. In addition, GOS scores have been found to change little after the first year post-injury (Snoek et al., 1981). Such a finding is inconsistent with other, generally more finely grained outcome research (e.g., Miller & Stern, 1965; Oddy et al., 1985) that suggests two years post-injury is more tenable as a plateau phase.

Nevertheless, the several studies that have utilized the GOS do provide some useful information on psychosocial outcome. Three studies (Crawford 1983; Levati et al., 1982; Snoek et al., 1981) have utilized relatively severely injured patients (i.e., required full intensive care, had GCS scores less than 7, and had PTA greater than 2 days, respectively). These studies found severe disability in 27.4%, 6.1%, and 20% of cases, moderate disability in 47%, 18.4%, and 40% of cases, and good recovery in 25%, 59.2%, and 40% of cases, respectively. The coarse, non-psychological orientation of the GOS is underlined by Crawford's (1983) comment that emotional and intellectual symptoms were the most distressing symptoms in his moderate and good outcome groups. Such distress is not consistent with what would be reasonably defined as "good outcome."

Rimel (1981) examined GOS scores for over 1000 consecutively admitted CHI and SCI patients. She reported the following results: 7% dead; 4% vegetative; 8% severely disabled; 12% moderately disabled; and 69% good recovery. Her sample's inclusion of many mild injuries undoubtedly accounts for the relatively optimistic results. Lundholm et al. (1975) used their own measure, which bears some resemblance to the GOS, to examine outcome after CHI. For 30 survivors who spent more than 7 days in coma, 15 of the 30 were "totally socially and personally independent," 7 of the 30 were able to conduct their own activities of daily living but were economically dependent, and 8 of the 30 were "totally helpless."

In conclusion, GOS studies suggest that there is a wide spectrum of outcome after severe CHI. This indicates that severity of injury measures only account for a portion of the variance in outcome measures. The conclusion that the GOS is too coarsely grained, especially at the "upper" end of the scale, is inescapable. The absence of work status as an outcome variable is a very real limitation of the scale. As Prigatano (1989) has indicated, it is well to consider a variety of outcome measures, but the bottom line for most adults is the ability to return to and sustain gainful employment. In a word, the GOS may best be described as a good <u>first step</u> toward a quantified measure of outcome.

<u>Emotional/Interpersonal Outcome</u>. This section is divided into four subsections. First, general personality changes that occur after CHI are discussed. In the next three sections, flagrant interpersonal difficulties, nonflagrant difficulties (e.g. fatigue), and disorders

involving awareness of deficits are discussed.

Personality changes that occur after head injury cause much more distress to the patient's family than do physical changes (Lewin & Roberts, 1979). In addition, such changes are far less likely to elicit sympathy or support than are physical disabilities (Jennett et al., 1981). For this reason, it is important to elucidate the nature and correlates of personality change after CHI.

The first group of studies to be considered examined personality change in a global sense; the precise types of changes were often not specified. Nevertheless such studies serve as an introduction to studies that better define the personality changes occurring after CHI. Studies examining the latter issues are reviewed later in this paper.

Thomsen (1984) found that 8 of 40 severe CHI patients developed "psychosis" during the 10 to 15 years following injury. None of these patients had been admitted to a psychiatric ward premorbidly. Two cases had onset within one year of CHI, whereas 6 had onset after one year. Several other studies (e.g., Brooks et al., 1986; Fordyce et al., 1983; Klonoff, Snow, & Costa 1986) have also found that personality change does not necessarily "get better" with time, but may, in some cases, worsen. Two reasons given for this finding are that (1) patients may become more aware of, and thus, more frustrated with their deficits as they try to do more, and as people expect more of them and/or (2) those patients who have personality/behavioral deficits are more likely to be referred for neuropsychological assessment. Some support for the first possibility is provided by longitudinal studies of CHI individuals (e.g., Brooks et al., 1986).

Two of three studies (i.e., Bond, 1976; Brooks et al., 1986; but not Steadman & Graham, 1969) that have examined personality change have found that its incidence does not correlate strongly with duration of PTA, especially in the long-term. In contrast, the degree of neuropsychological impairment has generally been found to correlate with personality change (e.g., Klonoff, Costa, & Snow, 1986; Weddell et al., 1980). However, Jennett et al. (1981) found that marked personality change was found in over 60% of patients whose physical and cognitive deficits were mild or nonexistent. Jennett et al.'s findings must be interpreted with caution, though, as data were solely based on a neurologist's judgement of cognitive, personality, and physical deficits. The examination may not have been sensitive enough to detect many cognitive changes that were extant.

Jennett et al's (1981) finding of little correlation between degree of physical deficit and degree of personality change has been replicated by other studies (e.g., Bond, 1976; Weddell et al., 1980). Two other variables that also do not appear to be correlated with personality change post-CHI are age and social class (Weddell et al., 1980).

In conclusion, when personality change post-CHI is examined in a global fashion, none of the following variables strongly correlate with it: severity of injury, physical impairment, age, or social class. Degree of neuropsychological impairment and time since injury have been found to correlate with personality change. The unexpected finding of increased personality problems at longer intervals following injury underscores the importance of conducting long-term followup studies.

The most flagrant types of personality change are considered next. These changes are readily apparent to the outside observer, and usually have interpersonal effects. They may be contrasted with less flagrant changes such as depression, which may be less obvious to the observer.

Perhaps the most commonly reported flagrant emotional change after CHI is increased irritability (Cartlidge et al., 1981; Klonoff, Snow, & Costa, 1986; Lewin et al., 1979; Thomsen, 19884; Van Zomeren & Van

Den Berg, 1985; Weddell et al., 1980). Both relatives and the patients themselves report this phenomena. It is particularly significant that patients admit this change as they are often reluctant to report other emotional changes that are apparent to relatives (McKinlay & Brooks, 1984; Van Zomeren & Van Den Berg, 1985).

Irritability after CHI is found in both those with relatively mild head injury (Klonoff, Snow, & Costa, 1986) and in those with more severe injury (e.g., Thomsen, 1984). It has been linked with frontal lobe damage (Lewin et al., 1979) and presumably results from the damaged frontal lobes' decreased ability to control the activities of the limbic system. Interestingly, in those studies that have reported an age effect (Lewin et al., 1979; Thomsen, 1974), younger patients have been found more likely to become irritable after CHI. Little explanation of this finding has been offered. It may be that younger people are less restrained under normal circumstances. When brain-damage occurs, young persons may be particularly unlikely to inhibit overt expressions of irritability. Finally, one study reported that relatives noted a decrease in the patient's irritability with the passage of time (Weddell et al., 1980). As the authors state, this may have been an artifact of the relatives coping better with such behavior.

A characteristic related to irritability, belligerence, is measured by the Katz Adjustment Scale - Relative's Version (KAS-R; Katz & Lyerly, 1963). Studies that have employed the KAS-R (Klonoff, Snow, & Costa, 1986; Newton & Johnson, 1985) have found CHI patients to score higher on the Belligerence scale than is the case for the normals supplied by Hogarty & Katz (1971). Fordyce et al., (1983) compared CHI patients within 6 months of injury to those more than 6 months post-injury and found that there was a trend for the more chronic patients to score higher on the Belligerence scale of the KAS-R. This finding is inconsistent with the results reported by Weddell et al,., (1980) noted above, that found relatives to report less irritability in patients as time progressed. However, there are several potential explanations for the discrepancy in findings. Two such explanations are the use of different instruments and the use of a retrospective/longitudinal design in the Weddell et al., (1980) study versus the use of a cross-sectional design in the Fordyce et al. (1983) study. Emotional lability is a characteristic that has been reported in at least some CHI patients (Cartlidge et al., 1981; Thomsen, 1984). As with irritability, Thomsen (1984) reported that emotional lability was more common in CHI patients who were younger than age 21 at the time of injury.

One of the most notorious correlates of CHI, which may be exacerbated by its sudden onset, is bad temper. Reduced control of temper has commonly been reported after CHI (e.g., Brooks et al., 1986; Oddy et al., 1985; Weinstein & Lyerly, 1968). Weinstein & Lyerly (1968) reported that severity of injury was not a predictor of bad temper in their group of CHI patients who had all suffered loss of consciousness of at least "several hours." The lack of correspondence between injury severity and such flagrant interpersonal misbehavior is consistent with the research on irritability reviewed above. This raises the question of the role of premorbid personality characteristics in problematic interpersonal behavior. Unfortunately, there has been little study of premorbid factors in the context of bad temper and violence post-CHI. However, in a slightly different context, Thomsen (1984) found that none of her eight patients who developed "psychosis" after severe CHI had been admitted for psychiatric treatment premorbidly. This argues for the importance of CHI, per se, in at least some post-traumatic behavior change.

Aggression and violence post-CHI have been reported by several investigators (e.g., Adey, 1963; Brooks et al., 1986; Thomsen, 1984). Such behavior has been found to increase from one to five years post-CHI, perhaps due to the increasing frustration felt by patients (Brooks et al., 1986). In one of the most suggestive, if not scientifically sound studies, Lewis, Pincus, Feldman, Jackson, & Bard (1986) reported on the characteristics of 15 inmates on "death-row" in the United States. The most interesting finding was that all of their death-row inmates had suffered head injuries during their lives. This was confirmed by examination of neurological histories. The severity of the head injuries ranged from mild to very severe, and most inmates had suffered their first injury during childhood. Although one cannot directly attribute the inmates' murderous behavior to their head injuries, it is certainly a provocative finding deserving further study.

Because the KAS-R is a measure to be used in the present study, results from previous studies that used the KAS-R are now briefly presented. Of the 13 commonly used subscales, research (Klonoff, Snow, & Costa, 1986; Newton & Johnson, 1986) has consistently found CHI patients to be more impaired than normals on the following subscales: Belligerence, Negativism, Suspiciousness, Withdrawal/Retardation, and Confusion. Findings on the Helplessness, Stability, General

Psychopathology, and Verbal Expansiveness scales have been mixed (Klonoff, Snow, & Costa, 1986; Newton & Johnson, 1986). The differences between the Klonoff, Snow, & Costa (1986) and the Newton & Johnson (1985) studies may have been in part due to the former's inclusion of patients with a wide range of injury severity. In contrast, patients in the latter study were more homogeneous, tending to have suffered more severe injuries. This hypothesis is supported by Klonoff, Snow, & Costa's finding of a strong relationship between GCS and KAS-R scores.

The same two studies compared Hogarty and Katz's (1971) psychiatric norms to scores obtained by CHI patients. The CHI patients scored better on the Anxiety, Nervousness, Hyperactivity, and General Psychopathology subscales in both studies. Belligerence and Verbal Expansiveness subscale scores did not differ between CHI and psychiatric groups in either study. Newton and Johnson (1985) found that their CHI patients did worse on the Confusion subscale than did the psychiatric controls. Klonoff, Snow, & Costa (1986) did not replicate this finding, perhaps because their CHI patients tended to be less severely injured. Klonoff, Snow, and Costa's CHI patients scored better than, while Newton and Johnson's CHI patients did not differ from, the psychiatric controls on the following subscales: Negativism, Bizarreness, Stability, Helplessness, Suspiciousness, and Withdrawal/Retardation. The aforementioned differences in injury severity between the two studies may account for a portion of these discrepancies, as may the small CHI sample size (N = 11) in the Newton and Johnson study.

One study (Fordyce et al., 1983) compared CHI patients within six months of injury to those after six months of injury. The two groups were similar on a variety of injury-related and demographic factors. Despite this apparent matching of groups, the chronic group was more impaired than the acute group on the following KAS-R subscales: General Psychopathology, Bizarreness, Belligerence, Negativism, and Helplessness. This is consistent with often-reported findings of an increase in emotional problems with the passage of time.

In conclusion, the troublesome interpersonal behavior most commonly reported by both patients and relatives is irritability. Relatives report that emotional lability, bad temper, and violence are also often seen. Severity of injury does not predict the nature or extent of flagrant interpersonal behavior problems very well. There has been little study of the importance of premorbid characteristics vis-a-vis the expression of such behavior problems post injury. Finally, perhaps surprisingly, the presence and extent of behavior problems may increase with time post-injury.

Behaviors that are not as flagrant are also seen after severe CHI. Perhaps the most common "cluster" of such behavior after CHI is apathy, lack of initiative, slowness, and tiredness (e.g., Ackerlund, 1959; Brooks et al., 1986; Cartlidge et al., 1981; Thomsen, 1984; Van Zomeren & Van Den Berg, 1985). Unfortunately, few of the correlates of such behaviors have been explored. Those studies that have examined correlates have found that "tiredness" does not necessarily decrease after one year post-CHI (Brooks et al., 1986) and may, in conjunction with apathy, actually increase (Thomsen, 1984).

Depression is another form of behavioral pathology seen after CHI (e.g., Adey, 1963; Cartlidge et al., 1981; Fordyce et al., 1983; Lewin et al., 1979). Although depression may arise in a patient who had previously been unaffected by it (Cartlidge et al., 1981; Lewin et al., 1979) there is evidence that, in some cases, post-CHI depression may be a continuance or an exacerbation of a premorbid characteristic (Cartlidge et al., 1981). For example, Cartlidge et al. (1981) reported that 31 of the 56 patients in their sample who were depressed post-CHI were also depressed prior to their accident. Fordyce et al., (1983) found that a group of CHI patients who were an average of more than two years post-injury scored higher on the Depression scale of the MMPI than did patients who were within 6 months of injury. This was found despite the fact that the two groups did not differ on a variety of demographic or neuropsychological variables.

Another commonly reported symptom seen after CHI is anxiety (Cartlidge et al., 1981; Fordyce et al., 1983; Lewin et al., 1979; Newton & Johnson, 1985; Oddy et al., 1985). As with depression, it has been reported that there is a high incidence (i.e., greater than 50%) of premorbid anxiety disorder in patients who exhibit anxiety post-CHI (Cartlidge et al, 1981). Some investigators (e.g., Lewin et al., 1979) have labelled the anxiety exhibited by some patients post-CHI a "neurotic" response to memory and other cognitive deficits. However, it can be argued that anxiety felt over cognitive deficits may instead be an appropriate response indicating an awareness of deficits, and may lead to the use of compensatory strategies to minimize the effects of cognitive deficits. As with depression, Fordyce et al., (1983) found that anxiety was more severe in their chronic group who were an average of more than two years post-injury than in those assessed less than six months post-injury. This was the case despite the two groups being similar on many demographic and neuropsychological parameters.

Newton and Johnson (1985) found that CHI patients were more socially anxious and had a greater fear of negative evaluation by others than did a control group of psychiatric outpatients referred for social interaction difficulties. The authors indicated that the severe CHI patient may become socially isolated because of such social interaction difficulties.

Lack of friends and loneliness are indeed common complaints cited by patients after CHI (Fordyce et al., 1983; Thomsen, 1984; Weddell et al., 1980). Parents may interact more and do more with the patient post-injury in an effort to make up for the loss of social contact (Weddell et al., 1980). Interestingly, while relatives complain most of personality and emotional changes in the patient, the patients tend to complain more of the loss of social contacts (Thomsen, 1984). Diminished awareness of self post-injury may contribute to this discrepancy between patient and relatives' complaints (see below). Thomsen (1984) reported that at 10 to 15 years post-injury, two thirds of her severely injured patients had no contact outside of close family members. Weddell et al. (1980) stated that social isolation does not result from lack of opportunity to make social contacts, as neither absence from work nor physical disability were related to social isolation. This suggests that it is what the CHI patient does with the contacts he or she has, rather than a lack of social contacts per se (at least initially) that often leads to social isolation.

As with depression and anxiety, Fordyce et al. (1983) found that social introversion was worse in patients who were in the chronic phase of recovery than in those in the acute phase. This finding was independent of degree of neuropsychological impairment. Fordyce et al.'s analyses of MMPI responses suggested the existence three factors after CHI:
(1) anxiety/depression, (2) disorganized or unusual thought content, and (3) social withdrawal.

In conclusion, the most common "non-flagrant" difficulties after CHI are apathy, lack of initiative, slowness, tiredness, depression, anxiety, and loneliness. As with more flagrant behavior, all such problems may actually increase with the passage of time post-injury.

Denial of the presence or degree of deficits after CHI is a commonly reported phenomenon (e.g., Deaton, 1986; Grosswasser et al., 1977; McKinlay & Brooks, 1984; Oddy et al., 1985; Thomsen, 1984; Weinstein & Lyerly, 1968; Wild, Posthuma, & Bowman, 1985). "Denial" is a loaded term, given its psychodynamic connotations. However, in the context of CHI, denial of deficit may possibly be due to organic factors (i.e., anosagnosia), psychological factors (e.g., a defence mechanism against anxiety), or both (Deaton, 1986).

Denial has been defined as minimization of current deficits and/or minimization of the degree to which deficits will persist in the future (Deaton, 1986). It has been operationally defined as the difference between the patient's admission of difficulties and relatives' or professionals' views of the same difficulties, or the difference between the perspective provided by formal assessment results and the perspective of the patient. All of these operational definitions have their limitations. For example, relatives' personalities may contribute substantial variance to patient-relative discrepancies. Specifically, McKinlay and Brooks (1984) found that relatives who were more "neurotic" rated their CHI relative as more impaired. Neuropsychological assessment results, while usually correlated with everyday life performance (Heaton & Pendleton, 1981) are far from perfect predictors. Clearly, some of the discrepancy between patient report and test results is due to weak and/or unknown ability of the tests to predict activities of daily living.

Despite such methodological flaws, discrepancies between the patient's and others' perspectives is correlated with several patient characteristics when this issue is examined more than two years post-CHI. Those more severely injured have been reported to deny their limitations more than those who suffered less severe injuries (Weinstein & Lyerly, 1968; Wild et al., 1985). Denial of deficits has been linked to presence of more severe behavioral disturbance (Grosswasser et al., 1977) and employment difficulties (Wienstein & Lyerly, 1968). These difficulties may result because patients may overestimate their abilities and "set themselves up" for frustration and failure. (For a more comprehensive review of unawareness of deficits after brain insult, see McGlynn & Schacter, 1989.)

Long-term psychosocial outcome after severe head injury: Conclusions. Although research into the long-term psychosocial outcome after CHI is beset by numerous methodological shortcomings (e.g., lack of control groups), several replicated findings have emerged. Most patients with very severe CHI do not return to the same employment that they held premorbidly, if they return to any at all. The probability of return to work is negatively correlated with injury severity.

Cognitive/behavioral factors (e.g., memory and personality changes) tend to predict return to work better than physical changes do. In addition to neuropsychological ability, job training and practical skills are vital for return to work.

Personality/emotional changes commonly seen after head injury include: irritability, emotional lability, bad temper, violence, apathy, lack of initiative, slowness, tiredness, depression, anxiety, loneliness, and unawareness (or denial) of deficits. Such changes (other than denial) are not strongly correlated with injury severity, and the little evidence that does exist suggests that premorbid characteristics may be related to personality/emotional changes. The incidence and severity of such changes (other than denial) may increase with time post-injury. Denial is associated with severity of injury and with greater behavioral disturbance. Age, per se, does not appear to bear a strong relationship to emotional/personality change post-CHI.

Traumatic Spinal Cord Injury and its Physical Sequelae

Traumatic SCI occurs at a considerably lower frequency than does CHI. Recent surveys (e.g., Kalsbeek et al., 1980) place the incidence rate of traumatic SCI at 5 per 100,000 population per year. As with CHI victims, SCI victims are disproportionately male (Rimel, 1981) and usually less than 40 years of age (Kalsbeek et al., 1980).

The disabling effects of traumatic SCI are more understandable once the anatomical structure and function of the spinal cord are understood. The spinal cord is continuous with the medulla oblongata of the brain and runs from the foramen magnum down to the first lumbar vertebra (Carpenter, 1986). Voluntary motor control is transmitted via descending fibre tracts from the cerebral hemispheres, through the brainstem, and downward through the spinal cord. Thus, with a complete transection of the spinal cord, there is total loss of voluntary control of structures innervated by spinal nerves below the level of the lesion.

There are 31 pairs of spinal nerves: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal. Afferent nerves that transmit sensory input, efferent nerves that transmit motor output, and autonomic nerves that innervate most of the viscera all have their cell bodies in the spinal cord.

Lesions to any of the first 3 cervical levels often lead to death because of total respiratory paralysis. This is because the phrenic nerve innervating the diaphragm emerges from the fourth cervical vertebra. Individuals with lesions at the fourth cervical vertebra tend to have a short life span because of frequent respiratory complications. Also of vital functional significance are the brachial and lumbar plexuses. These cell body enlargements run from the fifth cervical to the first thoracic cord segments and from the first to the fourth lumbar cord segments, respectively. The brachial plexus gives rise to nerves that innervate the upper limbs, while the lumbar plexus gives rise to nerves that innervate the lower limbs.

Individuals who suffer SCI at any of the cervical levels (and survive) suffer quadriplegia while those with lower lesions suffer paraplegia. A spinal cord transection may be complete or incomplete. The functional consequences of SCI vary, with complete sections generally leading to greater loss of function than incomplete transections. This is because incomplete transections spare enough conducting fibres to allow some, albeit often reduced, functioning below the lesion level.

Traumatic SCI is the end result of injury to the spinal cord due to concussion (i.e., jarring), contusion (i.e, bruising), compression, laceration, puncture, and/or transection. The bony spinal column may or may not be fractured and/or dislocated (O'Connor & Leitner, 1971). The several stages of physiological dysfunction that follow during the acute portion of recovery will not be reviewed here because of the current paper's emphasis on long-term outcome. Instead, outlined in Table 1 are many of the long-term functional effects associated with spinal cord injury at various levels. The Table outlines optimal outcome after complete transection at a given level. As can be seen, higher lesions tend to be associated with poorer functional outcome. It should be noted that several other factors such as associated injuries or motivation may reduce performance below the levels outlined in Table 1.

Not outlined in the Table are some other effects either directly and/or indirectly related to SCI. These include incontinence of urine (O'Connor & Leitner, 1971), decubiti due to continuous pressure on one area of skin (O'Connor & Leitner, 1971), and sexual dysfunction (Griffith, Tomko, & Timms, 1973). Urinary incontinence is often treated by means of a catheter and bag or by condom drainage. Fecal incontinence is less common. Control of defecation can be trained by capitalizing on the gastro-colic reflex, which is an increase in intestinal peristalsis after food enters the empty stomach (Guttmann, 1976). With regard to sexual

Table 1

Effect of SCI Lesion Level on Functional Abilities[‡]

	Lesion Level	Feeding	Bathing and Dressing	Grooming
Nerves innervating neck, upper limb, and diaphragm muscles	C1	D	D	D
	C2	D	D	D
	C3	A,Ad	D	A,Ad
	C4	A,Ad	D	A,Ad
	C5	S	A,Ad	S,Ad
	C6	S,Ad	A,Ad	I,Ad
	C7	I,Ad	S,Ad	I,Ad
	C8		S,Ad	
	T1		S,Ad	
Nerves innervating chest and abdominal muscles	T2			
	T3			
	T4			
	T5			
	T6			
	T7			
	T8			
	T9			
	T10			
	T11			
	T12			
Nerves innervating hip and knee muscles	L1			
	L2			
	L3			
	L4			

Lesions affecting levels L5/S1 and S2 to S4 lead to little or no loss of functional independence. These two levels innervate the hip, knee, ankle, and foot and the bowel, bladder, and sex organs, respectively.

Table 1 (continued)

	Lesion Level	Toileting	Housework	Driving
Nerves innervating neck, upper limb, and diaphragm muscles	C1	D	D	D
	C2	D	D	D
	C3	D	D	D
	C4	D	D	A,Ad
	C5	D	A,Ad	I,Ad
	C6	A,Ad	A,Ad	I,Ad
	C7	S,Ad	S,Ad	I,Ad
	C8	I,Ad	S,A	I,Ad
	T1		S,Ad	I,Ad
Nerves innervating chest and abdominal muscles	T2		I,Ad	I,Ad
	T3			I,Ad
	T4			I,Ad
	T5			I,Ad
	T6			I,Ad
	T7			I,Ad
	T8			I,Ad
	T9			I,Ad
	T10			I,Ad
	T11			I,Ad
	T12			I,Ad
Nerves innervating hip and knee muscles	L1			I,Ad
	L2			I,Ad
	L3			I,Ad
	L4			I,Ad

Lesions affecting levels L5/S1 and S2 to S4 lead to little or no loss of functional independence. These two levels innervate the hip, knee, ankle, and foot and the bowel, bladder, and sex organs, respectively.

Table 1 (continued)

	Lesion Level	Public Transport	Wheelchair Transfers	Ambulation
Nerves innervating neck, upper limb, and diaphragm muscles	C1	D	D	D
	C2	D	D	D
	C3	D	D	D
	C4	D	D	A,Ad
	C5	D	A,Ad	I,Ad
	C6	A,Ad	A,Ad	I,Ad
	C7	S,Ad	S,Ad	I,Ad
	C8	I,Ad	S,A	I,Ad
	T1		S,Ad	I,Ad
Nerves innervating chest and abdominal muscles	T2		I,Ad	I,Ad
	T3			I,Ad
	T4			I,Ad
	T5			I,Ad
	T6			I,Ad
	T7			I,Ad
	T8			I,Ad
	T9			I,Ad
	T10			I,Ad
	T11			I,Ad
	T12			I,Ad
Nerves innervating hip and knee muscles	L1			I,Ad
	L2			I,Ad
	L3			I,Ad
	L4			I,Ad

Lesions affecting levels L5/S1 and S2 to S4 lead to little or no loss of functional independence. These two levels innervate the hip, knee, ankle, and foot and the bowel, bladder, and sex organs, respectively.

Table 1 (continued)

	Lesion Level	Telephone	Bed Mobility	Vocational
	C1	I,Ad	D	I,Ad
Nerves innervating neck, upper limb, and diaphragm muscles	C2	I,Ad	D	I,Ad
	C3	I,Ad	D	I,Ad
	C4	I,Ad	D	I,Ad
	C5	I,Ad	A,Ad	I,Ad
	C6	I,Ad	S,Ad	I,Ad
	C7	I,Ad		I,Ad
	C8	I,Ad		I,Ad
	T1			
	T2			
	T3			
	T4			
	T5			
Nerves innervating chest and abdominal muscles	T6			
	T7			
	T8			
	T9			
	T10			
	T11			
	T12			
Nerves innervating hip and knee muscles	L1			
	L2			
	L3			
	L4			

Lesions affecting levels L5/S1 and S2 to S4 lead to little or no loss of functional independence. These two levels innervate the hip, knee, ankle, and foot and the bowel, bladder, and sex organs, respectively.

*Table obtained from Chedoke-McMaster Hospitals.

D=Dependent, A=Assistance required, S=Supervision required, Ad=Assistive device required, blank space indicates activity can be performed independently.

dysfunction, erection is generally less affected than is ejaculation; studies have reported erections in between 54% and 87% of SCI men whereas ejaculation is reported in only between 3% and 20% of men (Griffith et al., 1973). Higher transections and more complete lesions are associated with greater sexual dysfunction than are lower and less complete lesions. The sexual abilities of women have been little studied, perhaps because of their ability to play a more "passive" role in sexual relations (Griffith et al., 1973).

In conclusion, the physical abilities of the SCI patient are related to the level of the spinal cord lesion. The higher the lesion, the greater the physical limitations. However, as is described below, a variety of other factors are associated with the extent to which the remaining physical abilities are fully utilized to lead a productive life.

Long-term Psychosocial Outcome after Spinal Cord Injury

This section is divided into two main sections. The first examines return to work or other "productive" activities two or more years post-SCI. The second section examines emotional/interpersonal outcome two or more years post-SCI.

Return to Productive Activity. The ability to return to productive activity or work after SCI is best placed in an historical context. Prior to World War II, approximately 80% of SCI victims did not even survive the first few months post-injury (Wittkower, Gingras, Mergler, Wigdor, & Lepine, 1954). The fact that return to work post-CHI is such a major issue in the literature today attests to how far the treatment of the SCI patient has come in the intervening years.

In their 1954 report, Wittkower et al. found that 24 of 30 SCI patients were unemployed. The state of rehabilitation and the mind set of the day undoubtedly led the authors to say that quadriplegics and those with almost intractable complications of spinal cord injury had little vocational potential.

In 1966, Symington and MacKay reported that 5 of 11 of their quadriplegic patients were able to work post-injury. The rehabilitation field had progressed to the point that the authors stated "...the management of quadriplegia is a challenge of mind over body" (p.391).

In 1969 Siegel reported that only 17% of a sample of traumatic quadriplegics were unemployed, with 34% in competitive employment and 47% in special vocational training programs or in college. They stated that quadriplegics were most often employed in "the professional, technical, managerial, sales, and clerical areas, occupations that can be successfully performed with minimal manual abilities if the person possesses the intellectual and educational qualifications" (p. 716).

Unfortunately most later studies (e.g., DeViVo, Rutt, Stover, & Fine 1987; Pinkerton & Griffin, 1983) have not found the high rates of employment reported by Siegel (1969). They have found, though, that educational and other qualifications are predictive of return to work post-SCI. In addition, several studies have broadened the definition of productive activity beyond gainful employment. Attendance at educational or vocational training classes (e.g, De Vivo, Rutt, Stover, & Fine, 1987; Weidman & Freehafer, 1981), and return to work as a homemaker (e.g., Yerxa & Baum, 1986) are but two outcomes that have been designated as "productive" activities post-SCI. The predictors of return to productive activity have tended to be similar regardless of how the term "productive activity" has been defined. Thus, the following review of return to productive activity makes few distinctions among the various ways in which it has been defined the literature. The prediction of productive activity is obviously important to most rationally allocate limited rehabilitation resources.

Perhaps the most counter-intuitive finding in the

SCI literature is that the level and completeness of the lesion is not reliably related to return to productive activity, (e.g., De Vivo & Fine, 1982; De Vivo et al., 1987; Goldberg & Feed, 1982; Kemp & Vash, 1981; MacDonald, Nielson, & Cameron, 1987). This is in contradistinction to findings reported previously for CHI where injury severity is related to return to productive activity. In SCI, the importance of other factors, which are not masked by the effects a serious brain injury, is evident.

One of the most commonly reported predictors of return to productive activity post-SCI is the level of educational attainment (Alfred, Fuhrer, & Rossi, 1987; Bahry-Kozak, 1987; De Vivo & Fine, 1982; De Vivo et al., 1987; Goldberg & Freed, 1982; but not Kemp & Vash, 1971). Educational attainment may not only leave the SCI victim with more non-physically demanding occupational options, but it is also a correlate of other relevant variables, such as locus of control (Bahry-Kozak, 1987).

Locus of control (Rotter, 1966) refers to the extent to which an individual experiences a sense of control over their destiny. Internal locus refers to a strong sense of such control, whereas external locus refers to the belief that one's destiny is controlled by outside, largely uncontrollable forces. An internal locus of control is related to a more active seeking of alternative solutions to problems (Heppner & Peterson, 1982). It is easy to see how one's proclivity to seek vocational alternatives after SCI could be related to level of productivity post-SCI, and this is indeed the case (Bahry-Kozak, 1987; Swenson, 1976).

Another (premorbid) characteristic that is related to productivity post-SCI is degree of productivity before injury. This relationship holds for pre- and post-SCI employment planning (Goldberg & Freed, 1973) in that similar vocational plans are held pre- and post-injury. The relationship also holds for actual pre- and post-SCI work status in that those gainfully employed at the time of injury are more likely to be employed more than 2 years post-injury (De Vivo & Fine, 1982) and those who spent a larger amount of time employed prior to injury are also more likely to spend more time employed post-injury (Goldberg & Freed, 1982).

Economic disincentive has been found to bear a strong relationship to return to work post-SCI (Bahry-Kozak, 1987; De Jong et al., 1984; Weidman & Freehafer, 1981). This relationship reflects the fact that the more insurance, lawsuit, or pension income one receives, the less likely one is to be gainfully employed. A large part of the reason for this phenomena is that the disabled individual may lose pension and/or other income if more than a modest sum of money from gainful employment is earned (Weidman & Freehafer, 1981). In contrast, those few studies that have examined any form of disincentive in the severely head injured during the chronic phase of recovery (e.g., Steadman & Graham, 1969) have found that there is no significant relationship between the amount of compensation settlement and the time taken for "recovery" and return to work. This difference between findings in SCI and those in CHI may have several explanations. First, it was not stated by Steadman and Graham if return to work would have resulted in loss of compensation. If it would not have, the lack of a relationship would be expected. Second, the severely head injured may be in less of a position to <u>chose</u> whether they will return to work. Brain-injury related variables may make that choice for them. Third, the way in which economic disincentive has been operationally defined in the spinal cord injury literature (see above) does not appear to have been applied to the severe CHI patient. It remains an empirical question whether or not economic disincentive as defined in the SCI literature is useful in predicting CHI patients' return to work.

Return to productive activity after SCI is generally not strongly related to age (Alfred et al., 1987; Goldberg & Freed, 1982; Kemp & Vash, 1971). Those studies that have noted a negative relationship between productivity and age have generally found that age only accounts for tiny percentage of the variance (e.g., 2.3%: DeJong et al., 1984). One study (DeVivo & Fine, 1982) found that those SCI patients who were less than 24 years old were much more likely to be gainfully employed than those older than 24 years. Unfortunately, no elaboration was provided. It may well have been that the two groups differed on another variable such as education level.

In the chronic stage of recovery from SCI there is little relationship between the amount time that has transpired post-injury and productivity status (Goldberg & Freed, 1973; Goldberg & Freed, 1982; De Vivo et al., 1987). Most of those who are going to return to productive activities appear to have done so by approximately 2 years post-injury.

Marital status has borne only a weak or nonexistent relationship to productivity post-SCI (Bahry-Kozak, 1987; De Vivo & Fine, 1982). However, one study (Goldberg & Freed, 1982) found a relatively strong positive correlation ($\underline{r}$ =.54) between number of children and return to work or school. This finding awaits replication.

No strong relationship has been found between gender and productivity post-SCI (De Vivo & Fine, 1982; Pinkerton & Griffin, 1983), although De Vivo and Fine did find a trend towards females being more productive post-injury. As the authors state, their finding may have been an artifact of the inclusion of "homemaker" as a productive outcome.

In conclusion, variables that are predictive of long-term return to productive activity after SCI include greater educational achievement, less economic disincentive, more internal locus of control, and consistent pre-morbid work history. Variables that are largely unrelated to return to productive activity include level of SCI lesion, age, gender, and injury-to-test interval (once it exceeds 2 years). In contrast to CHI findings premorbid variables are relatively more important than are injury-related variables in predicting return to productive activity post-SCI.

<u>Emotional/Interpersonal Outcome</u>

Perhaps the most important contribution of empirical research on emotional outcome after SCI has been the refutation of "stage" theories of adjustment after injury (Caplan & Shechter, 1987). Non-empirical reports (e.g., Kerr & Thompson, 1972; Orboan, 1985) have suggested that there are inevitable stages of adjustment to SCI. For example, Kerr & Thompson (1972) offered the following stages: (1) Initial mental shock, fear, and anxiety, (2) grief and mourning, and (3) anger and rebellion. Such a model is perhaps best put into perspective by SCI patients themselves, who have indicated that the most distressing part of their post-injury rehabilitation was that staff members kept telling them that they should be depressed (Lawson, 1977, cited in Caplan & Shechter, 1987).

In fact, there is a range of emotional response to SCI. Responses have been found to vary on a variety of dimensions, including level of stress experienced (Frank & Elliot, 1987) and style of coping used (Frank, Umlauf, Wonderlich, Askanazi, Buckelew, & Elliot, 1987). When groups of SCI patients are compared to normal non-SCI individuals there is usually little difference in psychopathology. This is the case regardless of whether a "broad-band" instrument such as the Minnesota Multiphasic Personality Inventory is used (e.g., Bourestrom & Howard, 1965) or if measures of life satisfaction (Decker & Schulz, 1985; Yerxa & Baum, 1986) or depression (Decker & Schulz, 1985) are used. An exception to this general finding was reported by MacBeath et al. (1989), who found that SCI patients scored in the impaired range on several scales of the Katz Adjustment Scale - Relative's version. However, the SCI and normative groups may have differed on several relevant variables such as level of education. This possibility was not addressed.

Emotional response in a given individual may well be related to premorbid personality (Kerr & Thompson, 1972; Wittkower et al., 1954) but few studies have actually gone beyond speculation and obtained premorbid measures of personality (Bracken & Shephard, 1980). The role of premorbid personality characteristics thus remains largely undetermined.

As is the case with work outcome, there is little or no relationship between the level of the spinal cord transection and degree of emotional distress experienced after SCI. This lack of a relationship has been reported when distress has been conceptualized in terms of depression (Decker & Schulz, 1985), life satisfaction (Decker & Schulz, 1985), or acceptance of disability (Woodrich & Patterson, 1983).

A variable that has received mixed support vis-a-vis level of emotional distress is the amount of time that has passed since the time of the injury. Some studies (e.g., Shadish, Hickman, & Arrick, 1981; Woodrich & Patterson, 1983) have reported that there is less distress with the passage of time, while other studies have reported no correlation of distress levels with time since injury (Frank & Elliot, 1987; Frank et al., 1987). There are at least two possible reasons for these discrepant findings. First, the studies used different measures. Frank et al. used the Beck Depression Inventory and the Symptom Checklist - 90, Shadish et al. (1981) used an interview, and Woodrich and Patterson used the Acceptance of Disability Scale. Second, all of the studies were cross-sectional. The studies finding a correlation may have employed subject groups that differed on relevant variables. One of the most relevant variables that may have differed between "earlier" and "later" groups in the prediction of emotional distress after SCI is "locus of control" (Rotter, 1966).

Research has consistently shown that individuals with a more internal locus are less likely to be distressed post-SCI, regardless of whether distress is conceptualized as depression (Decker & Schulz, 1985; Frank et al., 1987), life stress (Frank et al., 1987; Shadish et al., 1981) or life satisfaction (Decker & Schulz, 1985). In addition, studies (e.g., Yerxa & Baum, 1986) that have found no differences between normal controls and SCI patients on "life-satisfaction" or "happiness" variables have demonstrated no differences in locus of control.

Locus of control is related to premorbid variables such as level of education (Bahry-Kozak, 1988). In fact, level of education has been found to have a similar relationship to distress post-SCI as does locus of control. Specifically, individuals with more education are found to be less distressed post-injury than are those with less education (Decker & Schulz, 1985; Woodrich & Patterson, 1983). Better educated and more internally focused individuals appear to feel more in control of their lives and less distressed, a finding consistent with cognitive theories of depression (e.g., Beck, 1976). Such theories state that individuals who are depressed often do not believe that they can do anything well (i.e., are not in control), and such individuals are thus pessimistic about themselves and the future. Regardless of whether such cognitive theories of depression explain the presence or absence of depression after SCI, the fact that education is correlated with degree of depression and distress post-CHI points to the importance of such pre-morbid variables in emotional outcome after SCI. It will be recalled that pre-morbid variables such as education were also important in the prediction of work status post-SCI.

The importance of premorbid characteristics, and the variability between SCI individuals, are illustrated in an interesting group of studies that have attempted to relate imprudent-prudent (or active-passive) personality styles to responsibility for one's injury. Kunce & Worley (1966) compared SCI patients who were active (i.e., imprudent) agents in their injuries to those who were passive (i.e., nonimprudent) agents in their injuries. Results on the Strong Vocational Interest Blank (SVIB) indicated that the active group scored higher on the "aviator" scale of the SVIB, which is related to attitudes of daringness and adventurousness. Kunce and Worley stated that such differences between active and passive groups probably predated the SCI, as the SVIB shows test-retest correlations of .74 after as long as 22 years.

Fordyce (1964) found that SCI individuals who were judged to have acted imprudently immediately before their accident scored higher than those judged to have not acted imprudently on the following MMPI parameters: 4, 3 minus 4 plus 100, obvious and subtle subscales of scale 4, and sum of the subtle subscales of MMPI scales 4 and 9. The imprudent group was significantly younger than the nonimprudent group, but as Fordyce stated, the importance of this difference is a moot point. Nonimprudent persons are less likely to have accidents and are more likely to be older if and when accidents do occur.

Rohe and Basford (1989) found that there were no differences on MMPI scales or subscales of 4 and 9, and 3 minus 4 plus 100 between groups of SCI patients who either did or did not have alcohol in their systems at the time of their SCI. Rohe and Basford stated that a possible explanation for the difference between their and Fordyce's findings was that there was no age difference between the blood-alcohol and no blood-alcohol groups in their study. In contrast, Fordyce's imprudent group was younger than his nonimprudent group. Another possible reason for the discrepancy between studies is that assuming equivalence of alcohol/no-alcohol and imprudent/non-imprudent groups is inaccurate. Specifically, merely because one has an undetermined amount of alcohol in one's system at the time of SCI does not necessarily mean that imprudent actions on the part of the patient caused their SCI.

In conclusion, there is little empirical support for an inevitable series of stages of emotional adjustment after SCI. Nor do there tend to be differences between SCI patient groups and control subjects on measures of emotional functioning, at least in the long-term (i.e., after more than two years post-

SCI). As with productivity outcomes, emotional outcome after SCI is most strongly associated with pre-morbid and presumably pre-morbid characteristics such as education and locus of control. Variables that tend to be unimportant vis-a-vis long-term emotional functioning include injury-to-test interval and level of the SCI lesion. Finally, there is some evidence that SCI patients can be divided into groups based on the degree to which they were responsible for their accident. Those who were more responsible for their accident have been found to score higher on a variety of measures of impulsivity and risk-taking.

<u>Research that has Directly Compared Long-term Psychosocial Outcome after CHI to that Seen after SCI</u>

Only one unpublished study (Stambrook, Moore, Peters, Zubek, & MacBeath, 1989) has compared long-term psychosocial adjustment after CHI to that seen after SCI. Stambrook et al. compared groups of SCI, moderately injured CHI, and severely injured CHI patients on psychosocial outcome measures. On the Katz Adjustment Scale - Revised, the severe CHI groups scored worse than the other two groups (who did not differ) on the following scales: Belligerence, Negativism, Helplessness, Suspiciousness, Withdrawal/Retardation, and General

Psychopathology. In addition, the severe CHI group scored worse than the SCI (but not the moderate CHI group) on the Confusion scale. On the Profile of Mood States (POMS) scale, the severe CHI patients scored worse than the other two groups on the Total Mood Disturbance scale as well as the Depression/Dejection and Confusion/Bewilderment subscales. On the Sickness Impact Profile (SIP), the severe CHI group scored worse than the other two groups on the Alertness scale. They also scored worse than the moderate CHI patients and showed a trend towards poorer performance than the SCI patients on the SIP Work scale.

In contrast, the SCI patients scored worse than all CHI patients on the Body Care/Movement, Mobility, Ambulation, and Overall Physical Concerns scales of the SIP. There was a trend towards a greater drop in socioeconomic status pre- to post-injury in the severe CHI group than in the other two groups. Stambrook et al. concluded that the cognitive dysfunction seen after severe CHI adds to the chronic medical disablement that is seen after SCI.

Unfortunately Stambrook et al. (1989) did not explicitly screen their SCI subjects for presence of CHI. This may have led to the confounding of CHI effects with SCI effects. In addition, all subjects in the study were married, which may limit the generalizability of the findings.

Rosenbaum & Najenson (1976) compared psychosocial outcome one year after SCI and head injury in a group of Israeli war veterans. They found that wives of the SCI veterans reported more difficulties than did wives of the head injured veterans only in the sexual domain. The head injured patients were more self-oriented, more dependent, more socially handicapped, and more deserted by old friends than were the SCI patients. The SCI patients were reported to be significantly more self-oriented and dependent than were normal controls. The authors opined that the cognitive effects of head injury exacerbate the self-orientation and dependency associated with long-term physical disablement.

Unfortunately, the results of the Rosenbaum and Najenson study may not be generalizable because the sample consisted of soldiers who no longer had financial concerns. In addition, the SCI and head-injury groups were not explicitly matched for age or education, both open and closed head-injury subjects were used, the subjects were only 1 year post-injury, and a non-standardized interview/questionnaire was used.

Long-term Psychosocial Outcome after CHI and SCI: Summary and Conclusions

There are several similarities as well as differences between SCI patients and severely injured CHI patients vis-a-vis long-term psychosocial outcome. Both groups of patients are disproportionately young, male, and injured in motor vehicle accidents, falls, and sporting events (e.g., diving). In addition, both groups' rates of productive activity are lower post-injury than pre-injury.

However, there are several differences between SCI and severely injured CHI groups. There are numerous personality/emotional problems commonly noted after severe CHI. These include: irritability, emotional lability, bad temper, violence, apathy, lack of initiative, slowness, tiredness, depression, anxiety, loneliness, and lack of awareness (or denial) of deficits. These difficulties (other than denial) are not strongly correlated with injury severity, and the little evidence that does exist suggests that premorbid characteristics may be related to personality/emotional difficulties. The incidence and severity of such difficulties may actually increase with time post-injury. Denial is associated with the severity of injury and with greater behavioral disturbance. Younger age is related to a small number of emotional/personality changes (i.e., increased irritability and emotional lability) after CHI.

In contrast to CHI, there are generally few emotional/personality differences between chronic SCI patients and control subjects. Emotional outcome after SCI is most strongly associated with pre-morbid characteristics such as education and with presumably pre-morbid characteristics, such as locus of control. Neither level of SCI lesion nor injury-to-test interval are reliably related to long-term emotional functioning.

Return to productive activity after CHI is correlated with injury severity. Cognitive/behavioral factors (e.g., memory and personality changes) tend to be better predictors of return to work than are physical changes. Return to productive activity after SCI is not related to the level of SCI lesion. The level of SCI lesion is indicative of the extent of physical dysfunction. As with the degree of physical dysfunction after CHI, degree of physical dysfunction after SCI is not strongly associated with return to productive activity.

Although cognitive and behavioral difficulties after CHI are strongly correlated with return to productive activity, this is not the case for SCI patients. SCI patients tend to exhibit few changes in cognitive and behavioral functioning after their injury, at least in the long-term. The important factors associated with return to productivity after SCI tend to be environmental factors such as "economic disincentive" and premorbid factors such as level of education and premorbid work history. In addition, presumably premorbid factors such as locus of control are also associated with return to productive activity post-SCI.

In conclusion, the weight of the evidence suggests that injury-related factors are of relatively greater importance vis-a-vis long-term psychosocial outcome after severe CHI than they are after SCI. The importance of premorbid factors that are associated with outcome after SCI may be masked by the devastating mental and behavioral effects of severe CHI. Indeed, as many CHI patient's relatives in Thomsen's (1984) study reported, the patient was no longer the same person. While such reports may represent the extreme end of the CHI outcome spectrum, they do illustrate the point that psychosocial outcome after CHI is often qualitatively different than that seen after other forms of chronic disability such as SCI.

Purpose

Several studies to date have examined psychosocial outcome after severe to very severe head injury.

Relatively few of these studies have examined long-term outcome (i.e., that of more than two years). In addition, no published study to date has utilized a control group to determine the extent to which long-term psychosocial disability after CHI is due to specific effects of the head injury as opposed to general, nonbrain-related impairment found with any chronic disabling condition such as SCI.

For reasons outlined in the literature review (e.g., demographic similarities) the present study utilized SCI patients as a control group for the study of long-term psychosocial outcome after severe to very severe CHI. All CHI and SCI patients were sent three self-report measures and one measure to be completed by a close friend or relative. The three self-report measures were (1) the Psychosocial Adjustment to Illness Scale - Self-Report (PAIS-SR; Derogatis & Lopez, 1983), a multidimensional scale of psychosocial outcome; (2) the Problem Solving Inventory (PSI; Heppner & Peterson, 1982), a measure of the individual's applied, everyday problem-solving process; and (3) a "Background Information Questionnaire" to obtain demographic information and an "economic disincentive" score for each patient. Ratings of the patient by a close friend or relative were obtained via the Katz Adjustment Scale-

Relatives' version (KAS-R; Katz & Lyerly, 1963). The KAS-R is a multidimensional rating scale that taps into adjustment and psychopathology domains. In addition, a socioeconomic status score (Blishen & McRoberts, 1976) based on occupation was assigned to each patient. The PAIS-SR, the PSI, the KAS-R, and socioeconomic status provided the scores that are the dependent variables for the hypotheses outlined below. The measures and their psychometric characteristics are described in greater detail in the Methodology section of this dissertation.

Three measures that were used as predictor variables for the CHI group were obtained from neuropsychological assessment conducted within two years of post-traumatic amnesia termination. The first measure was an Average Impairment Rating (AIR) and the second and third were scores derived from the Minnesota Multiphasic Personality Inventory (MMPI). The first MMPI score was the sum of scales 1, 2, and 3, while the second MMPI score was the sum of scales 4 and 9. The rationale for these measures, and the method used to calculate the AIR, are described in the Methodology section of this dissertation.

Hypotheses

Hypothesis one. Hypothesis one states that CHI patients will be more impaired than SCI patients on the

KAS-R total score and the following KAS-R scales: Belligerence, Negativism, Helplessness, Suspiciousness, Withdrawal/Retardation, General Psychopathology, and Confusion, but not Verbal Expansiveness, Anxiety, Nervousness, Bizarreness, or Hyperactivity. These results are expected based on the findings of Stambrook et al. (1989) who compared SCI and severe CHI patients on the KAS-R. However, Stambrook et al.'s SCI subjects were not explicitly screened for presence of CHI.

Hypothesis two. Hypothesis two states that the CHI group will score worse than the SCI group on the PAIS-SR total score and the following PAIS-SR subdomains: Domestic Environment, Social Environment, Psychological Distress, and Vocational Environment, but not Health Care Orientation. The first three of these subdomain results are predicted based on the extensive research reviewed above that delineates the emotional and interpersonal difficulties that are encountered by severe CHI patients but not by most SCI patients. The Vocational Environment difference is predicted based on the findings of Stambrook et al. (1989) who reported a trend towards poorer "Work" domain scores for CHI patients than SCI patients on the Sickness Impact Profile. One factor that may reduce differences on many subdomains below levels that they might otherwise reach is the CHI patient's possible lack of awareness (or his/her denial) of difficulties post-CHI. Nevertheless it is expected that the differences should be great enough to attain statistical significance. There is no a priori reason to expect a difference between the groups on Health Care Orientation.

As a followup to hypotheses one and two, discriminant function analysis will examine which PAIS-SR and KAS-R scores best separate the SCI and CHI groups. To retain a somewhat acceptable subject to variable ratio, only those subscale scores ($\underline{N}$ = 11) from the above analyses that were hypothesized to differ significantly between the two groups will be included as predictor variables. No a priori prediction is made for this analysis.

Hypothesis three. Hypothesis three states that there will be a greater drop in socioeconomic status for premorbidly employed CHI subjects than for premorbidly employed SCI subjects. This hypothesis is offered based on the findings of Stambrook et al. (1989).

Hypothesis four. Hypothesis four states that the correlation between the PAIS-SR Vocational Environment scale and the difference between pre- and post-injury socioeconomic status would be stronger for the SCI group than for the CHI group. This is because CHI subjects are less likely to accurately assess the extent to which their injury is associated with their drop in socioeconomic status given their lack of awareness (or denial) of deficits.

Hypothesis five. Hypothesis five will examine the prediction of vocational outcome as measured by the PAIS-SR Vocational environment scale and the post-injury socioeconomic status scores. Hypothesis five consists of two parts. The first part is as follows: For the CHI group, it is predicted that PTA duration, AIR score, and the two MMPI scores will contribute significant variance to the prediction of each of the two measures. Education level is predicted to not contribute to outcome variance, as cognitive deficits will be expected to reduce the strength of factors that may be relevant in a non-brain injured population. In contrast it is hypothesized that education level, PSI score, and pre-injury SES will contribute significant variance to prediction of the two occupational outcome measures for the SCI group. Level of SCI lesion is not expected to contribute significant predictive variance. The point of the first part of hypothesis five is to confirm the importance of premorbid factors in prediction of vocational outcome for SCI patients and the importance of injury-related variables for CHI patients.

The second part of hypothesis five is identical to the first part, with the exception that the economic disincentive variable will be included as a potential predictor variable. Economic disincentive is actually best classified as a concurrent variable because it delineates the patients' current source of income and specifies how much they believe they would have to earn to make employment worthwhile. It is hypothesized that the economic disincentive score will add a statistically significant amount of predictive variance over and above that contributed by the predictor variables from the first part of hypothesis five. This is expected for both the CHI and SCI groups because the economic disincentive score contains information regarding the patient's current work status. However, the economic disincentive score also takes into account other vital information such as the amount of money one would have to earn to make giving up one's pension(s) worthwhile.

Hypothesis six. Hypothesis six is based on previous research that suggests there are personality score differences between subjects who are "active" agents in their accidents (i.e., are imprudent) and those who are "passive" (i.e., non-imprudent) agents.

The records of all patients will be examined to derive imprudent and nonimprudent subgroups within each of the SCI and CHI groups. For SCI, imprudent agents would have dived head-first into very shallow water, been driving while drunk, or been involved in similar events that clearly demonstrate complicity. "Nonimprudent" SCI patients would have documentation that showed they did not suffer their injuries as the result of a dive into very shallow water or that they were otherwise "innocent" victims in their accident. Such instances would include being a passenger in vehicle that was involved in an accident, or being awarded money from a lawsuit that implicated another party. Similar criteria would be used to divide up CHI patients into subgroups. Cases that do not clearly fall into either group will be excluded from the analyses.

For the CHI patients it would be predicted that imprudent subjects would score worse than nonimprudent subjects on the total score of the PSI, higher on scale 4 of the MMPI, lower on scale 5 of the MMPI (if male), and higher on the difference between scales 4 and 3 (i.e., 4 minus 3). These have all been suggested to be measures of "acting out," or poor problem solving/judgement (Graham, 1987; Heppner & Peterson, 1988).

Next, imprudent and nonimprudent CHI subjects will be compared to imprudent and nonimprudent SCI subjects on the PSI total score, using a two way (injury-type by imprudent/nonimprudent) analysis of variance. It is hypothesized that there will be a main effect for imprudent/nonimprudent, but not for injury type. The purpose of this analysis is to show that in terms of impulsivity there are probably some CHI patients who are more similar to certain SCI patients than to other CHI patients. This hypothesis cuts across the stereotype that injury-type is of overriding importance vis-a-vis one's personality characteristics. The fact that impulsivity is sometimes found after CHI would work against hypothesis seven being supported. However, it is hypothesized that post-CHI impulsivity will not totally mask pre-injury differences in problem-solving styles and judgement.

Hypothesis seven. Hypothesis seven simply states that the imprudent group will be younger than the nonimprudent group. This is based on the thesis that if one takes risks, one is more likely to be hurt more often and sooner than one who takes fewer risks (Fordyce, 1964).

CHAPTER II

METHODOLOGY

Subjects and Procedure

Subjects are closed head injury (CHI) patients and spinal cord injury (SCI) patients who were seen at Chedoke-McMaster Hospitals in Hamilton, Ontario. Several inclusion criteria were used. The CHI patients suffered severe or very severe CHI as reflected in a PTA of one week or more (Jennett & Teasdale, 1981). All CHI subjects were at least two years post PTA termination so that long-term outcome could be addressed. Using PTA termination to testing as the interval rather than injury-to-test interval avoided confounding severity of injury with time since injury. The CHI patients received a neuropsychological assessment during the first two years post-PTA termination. If more than one assessment was conducted during this period, the results of the first assessment were utilized in data analyses to avoid contamination from practice effects.

The subjects comprising the SCI group were also at least two years post-injury. All suffered traumatically induced SCI and were dependent upon assistive devices for ambulation. These criteria were employed to enhance comparability of CHI and SCI groups in the critical areas of severity of injury, acute onset, and existence of longstanding disability. Level of SCI was quantified by use of the Eggert Scale (Eggert, in Bahry-Kozak, 1987; see Appendix D). Both paraplegics and quadriplegics were included because previous research has shown level of spinal cord transection to be unrelated to measures of psychosocial outcome.

Unlike previous research with traumatic SCI patients, the SCI patients in the present study were screened for co-existing head injury, which is believed to occur in approximately 50% of SCI patients (Davidoff et al., 1988). This exclusion criterion was employed to avoid confounding the effects of CHI with those of SCI. Hospital records were searched to ensure that no SCI patient was included who suffered any loss of consciousness, loss of anterograde memory, or orientation disturbances suggestive of PTA. Patients with very mild head injuries may not have been detected by this screening but the effects of such trivial head injuries are almost always undetectable by two years post-injury (Levin, Eisenberg & Benton, 1989) and are not likely to significantly influence outcome.

In order to maximize random selection within the constraints imposed by inclusion criteria, files were to be searched alphabetically by surname until 75 CHI and SCI patients were obtained. In fact, when the files were searched, all CHI and SCI program files had to be examined to locate approximately 75 patients from each group who met selection criteria, and for whom correct addresses could be found.

The procedure that followed subsequently was based on that of Donaghy (1988). Specifically, wherever possible, subjects were first contacted by telephone and told about the project, told that they would be paid $17.50 and a relative would be paid $7.50 if they participated, informed that a package of materials would be mailed to them, requested to fill out the questionnaires and return them, asked if they had any questions, and thanked for their time. Subjects who could not be reached by telephone but for whom a proper address was available also had the package of materials mailed to them.

A total of 70 CHI patients and 77 SCI patients were sent packages. Sixty-one (87%) of the packages sent to CHI patients were returned. Fifty-seven of these (81% of the 70 sent out) were utilized for subsequent data analyses. Of the four that were not used, two individuals declined to participate and returned the blank questionnaires. Two others returned the questionnaires with a large number of questions unanswered.

Of the 77 SCI patients who were mailed packages, 53 (69%) returned them. Data from 50 of the 53 returned packages were utilized for subsequent data analyses. Of the three that were not used, one declined to participate and returned the blank questionnaires and two returned the questionnaires with large numbers of questions unanswered.

Table 2 presents the pre-injury demographic characteristics of the CHI and SCI groups. Inspection of Table 2 indicates that there are no statistically significant differences between the groups on age, education, socioeconomic status, sex ratio, or marital status.

Table 3 presents accident and post-accident related demographic variables for the two groups. Consistent with results reported in the literature, the most frequent cause of both SCI and CHI was motor vehicle accident. The second most frequent cause of SCI was diving accidents, while motorcycle accidents were the second leading cause of CHI. All SCI subjects required assistive devices for ambulation (92% required a wheelchair), whereas only 18% of CHI subjects required any assistive devices for ambulation (9% required a wheelchair). There was no statistically significant

Table 2

Pre-injury Demographic Characteristics and Statistical Comparisons of CHI and SCI Patients[a]

	CHI	SCI	*df*	*t*	*p*
M Age at injury	26.05	25.24	104	-0.42	n.s.
SD	9.87	10.07			
M Years education	12.21	11.52	104	-1.61	n.s.
SD	2.29	2.14			
M Pre-injury socioeconomic status	31.47	31.72	105	0.10	n.s.
SD	13.94	11.96			
Sex[b]					
Male	46	41			
Female	11	9			
Marital Status[c]					
Single	38	35			
Married	15	12			
Divorced	1	1			
Other	3	2			

[a]CHI N=57, SCI N=50; Number of subjects sometimes varies slightly between analyses, because data on some parameters was missing for a few subjects.

[b]χ^2 (1) = .00, p = 1.00.

[c]χ^2 (3) = .20, p = .98.

Table 3

Accident and Post-Accident Related Demographic Variables and Statistical Comparisons of CHI and SCI Patients

	CHI	SCI	df	t/X^2	p
Accident type			8	27.97	.001
Car/truck	36	17			
Motorcycle	12	5			
Diving	0	13			
Fall	2	7			
Industrial	3	5			
Sports-related	1	2			
Bicycle	1	0			
Fight	1	0			
Unspecified	1	1			
Mobility status			4	81.47	.001
Electric wheelchair	1	15			
Manual wheelchair	4	31			
Cane	5	3			
Walker	0	1			
No assistive device	47	0			
KAS-R informant			9	5.20	n.s.
Friend	7	10			
Mother	17	16			
Father	3	1			
Sister	6	4			
Brother	2	0			
Wife	12	10			
Husband	4	3			
Fiancee	3	4			
Care giver	1	1			
Not stated	0	1			
M Age now	31.60	34.22	105	1.29	n.s.
SD	9.97	11.00			
M Months post-injury	56.20	87.79	66.55	4.05	.001
SD	26.36	43.59			

difference between the groups in terms of the relationship to the person who completed the Katz Adjustment Scale - Relatives Form, nor was there any difference in current age of the CHI and SCI groups. More months had elapsed from injury to execution of the present study for the SCI than the CHI patients. The importance of this appears to be negligible as the correlations presented in Table 4 indicate that months post-injury are not correlated with any outcome variable.

Material

The four questionnaires used were: (1) the Katz Adjustment Scale - Relative's form (KAS-R), (2) the Psychosocial Adjustment to Illness Scale - Self-report form (PAIS-SR), (3) the Problem Solving Inventory (PSI), and (4) a "Background Information Questionnaire" specifically designed for this study (see Appendix C). The SCI and CHI patients completed the PAIS-SR, the PSI, and the Background Information Questionnaire. The relative or friend completed the KAS-R.

KAS-R. The KAS-R consists of 127 items that are each rated as occurring from 1 (not at all) to 4 (very frequently). Thirteen domain scores and a total score are obtained. The 13 domain scores are: Belligerence, Verbal Expansiveness, Negativism, Helplessness, Suspiciousness, Anxiety, Withdrawal and Retardation,

Table 4

Correlations of Outcome Variables with Number of Months Post-injury for CHI, SCI, and Total Patient Sample[a]

Outcome Variable	CHI	SCI	Total Sample
Katz Adjustment Scale-Relative's Form			
Belligerence	-.17	.09	-.03
Verbal Expansiveness	.01	.03	-.01
Negativism	-.07	-.07	-.10
Helplessness	-.02	.06	-.06
Suspiciousness	.15	.06	.04
Anxiety	-.23	.16	.05
Withdrawal and Retardation	-.06	.07	.06
General Psychopathology	-.12	-.03	-.14
Nervousness	.04	.25	.13
Confusion	-.10	.10	-.09
Bizarreness	-.01	-.20	-.14
Hyperactivity	-.07	-.03	-.08
Stability	-.12	-.03	-.08
Total score	-.10	.05	-.08
Psychosocial Adjustment to Illness Scale - Self-Report			
Health Care and Orientation	-.03	-.03	-.09
Vocational Environment	-.14	.30	.18
Domestic Environment	-.09	.13	.21
Social Environment	-.02	-.01	.01
Psychological Distress	-.22	.05	-.03
Total score	-.14	.16	.10
Problem Solving Inventory total score	-.19	.14	-.08
Present Socioeconomic Status	-.01	.12	.14

[a]None of the correlations are statistically significant.

General Psychopathology, Nervousness, Confusion, Bizarreness, Hyperactivity, and Stability. Factor analytic research (e.g., Katz & Lyerly, 1963) and other studies (e.g., Hogarty, Katz, & Chase, 1971) support the reliability and validity of these domains. In addition, the KAS-R has been used in both CHI studies (eg., Newton & Johnson, 1985) and SCI studies (e.g., MacBeath, Stambrook, Moore, Peters, & Zubek, 1989) and has been found to be sensitive to adjustment difficulties associated with each (e.g., Stambrook et al., 1989). The KAS-R is presented in Appendix C.

PAIS-SR. The PAIS-SR consists of 46 multiple choice questions divided into 7 domains. A total score is also calculated. The 7 domains are:

1. Health Care and Orientation: Attitudes towards physicians and treatment.
2. Vocational Environment: Disruption in job performance, satisfaction, and adjustment that is due to the illness.
3. Domestic Environment: Illness induced difficulties that arise primarily in the home.
4. Sexual Relationships: Shift in quality of sexual behavior or relationships due to illness.

5. Extended Family Relationships: Difficulties in relationships with the extended family, due to illness.
6. Social Environment: The degree to which illness has impaired the patient's social and leisure activities.
7. Psychological Distress: The degree to which psychological difficulties have arisen in association with the "illness."

Two of these domains were not utilized in the present analyses: Sexual Relationships and Extended Family Relationships. Extended Family Relationships was excluded because it is the one subdomain that has been found by previous research to be unreliable (Weissman, Sholomskas, & John, 1981). The Sexual Relationships domain was excluded because previous research (Donaghy, 1988) found that many CHI patients refuse to complete this section. It was anticipated that many SCI patients would also refuse to complete this section. The deletion of these two sections should not be of major concern in analyses that entail use of a total PAIS-SR score as the remaining 5 domains that will be used have all been shown to be reliable and valid (Weissman et al., 1981). In addition to being found a reliable and valid measure by previous research, the PAIS-SR has also been utilized in previous CHI research (e.g., Donaghy, 1988). The PAIS-SR is presented in Appendix C.

PSI. The PSI (Heppner & Peterson, 1982) is factor analytically derived instrument that examines the dimensions underlying the applied, everyday problem-solving process. It consists of 35 self-rating items on a 6-point Likert-type scale. The three dimensions obtained by factor analytic research are: (1) Problem-solving Confidence (11 items; e.g., Many problems I face are too complex for me to solve), (2) Approach-Avoidance Style (16 items; e.g., When confronted with a problem, I tend to do the first thing that I can think of to solve it) and (3) Personal Control (5 items; e.g., Sometimes I get so charged up emotionally that I am unable to consider many ways of dealing with my problems).

The PSI total score has been found to be uncorrelated with intelligence and social desirability measures in normal subjects (Heppner & Peterson, 1982). In contrast, it was found to be related to personality variables such as locus of control and general perception of problem solving skills, and is amenable to change through specific skill training in problem solving (Heppner & Peterson, 1982). In an assertiveness training program, judges who were blind to subjects' PSI scores rated better (i.e.,lower) scorers as more assertive and more effective problem solvers than those scoring high on the PSI (Larson, 1984, in Heppner, 1988). Those with higher scores on the PSI also had more "pathological" MMPI profiles than did lower scorers (Heppner & Anderson, 1985). Even though the PSI has not been heretofore applied to psychosocial outcome research after CHI or SCI, its promising psychometric characteristics make it an attractive research tool. In addition, it allows for the study of individual problem-solving styles without the necessity of administering a lengthy, cumbersome measure such as the Minnesota Multiphasic Personality Inventory.

Background Information Questionnaire. The questionnaire specifically designed for this study is shown in Figure 1. The "Economic Disincentive" score, derived from questions 15 and 16, is drawn from Bahry-Kozak (1987) who found the score to be strongly predictive of productivity post-SCI. The Economic Disincentive score is calculated by adding the scores obtained from questions 15 and 16, according to the following method: Question 15: a or b = 1, c or d = 2, e or f =3, g or h = 4, i or j = 5, k or l = 6; Question 16, a = 1, b = 2, c = 3, d = 4, e = 5, f = 6. The total score for the "Economic Disincentive" variable may thus range from 2 to 12.

Figure 1

<u>Background Information Questionnaire</u>

1) What was your marital status at the time of your accident?

___ Single ___ Married ___ Divorced ___ Other

2) What is your marital status now?

___ Single ___ Married ___ Divorced ___ Other

3) How many years of education did you complete before your injury? (Count beginning from grade 1)

____

4) How many years of education have you completed since your accident?

____

5) What did you do for a living before your injury (please be specific; if a student please state the type of program you were in)?

____

6) If you were a student at the time of your injury, what was the occupation of the primary wage-earner (e.g., father or mother) in your family?

____

7) If you are currently doing paid work, please describe the work you do.

____

8) If you are a currently a student please describe the type of program you are in.

____

9) Is your primary role that of a home-maker?

__yes ___no

10) Are you currently unemployed? __Yes __No

11) What is your current mobility status? Do you usually

__ Use an electric wheelchair

__ Use a manual wheelchair

__ Walk with a cane

__ Walk with crutches

__ Walk using a walker

__ Walk completely independently

12) How many people, other than yourself, were financially dependent on you at the time of your injury?

__0 __1 __2 __3 __4 __5 __more than 5

13) How many people, other than yourself, are financially dependent on you now?

__0 __1 __2 __3 __4 __5 __more than 5

14) At the time of your injury, were you

__ Employed full-time

__ Employed part-time

__ in school

__ Unemployed but had worked full time during the two years prior to injury

__ Unemployed but had worked part time during the two years prior to injury

__ had worked some time in the past

__ had never worked

15) What is your present source of income (circle one letter)

A) full time employment plus lawsuit settlement
B) full time employment only
C) part-time employment plus lawsuit settlement
D) part time employment only
E) part-time employment plus disability pension
F) disability insurance settlement plus Canada Pension
G) disability insurance settlement only
H) Workman's compensation pension only
I) Workman's compensation pension plus Canada Pension
J) Canada Pension only
K) Canada Pension plus provincial disability (GAINS-D)
L) Provincial disability (GAINS-D pension only).
M) other (Please specify)

____

16) What amount of money per year would you estimate you would need to earn from employment to make it financially possible for you to discontinue your government or insurance pension? If you are already employed, what is the least amount of money you would accept per year to make employment worthwhile? (Circle one)

A) $15,000 - $19,000
B) $20,000 - $24,000
C) $25,000 - $29,000
D) $30,000 - $34,000
E) $35,000 - $39,000
F) $40,000 or more

17) Have you ever, in any way, been affected by your injury?
___ yes ___ no

Each CHI patient had an Average Impairment Rating (AIR; Russell, Neuringer, & Goldstein, 1970) calculated from the neuropsychological test scores obtained during the two years after PTA termination. The purpose and rationale of the AIR are described in the literature review above, and the calculation of the AIR is described in detail in Appendix B.

To examine the association between emotional status and later psychosocial outcome for the CHI patients, MMPI data associated with the neuropsychological assessment were also utilized. Two scores, drawn from previous empirical research on the MMPI and CHI (i.e., Klonoff, Costa, & Snow, 1986), were used. The first score is the _t_-score sum of MMPI scales 1, 2, and 3. The second score is the _t_-score sum of MMPI scales 4 and 9.

Socioeconomic status was assigned according to the revised Blishen scale (Blishen and McRoberts, 1976). This scale assigns a score to each of approximately 500 occupational groups. Scores range from 14.3963 to 75.2846. Because the Blishen scale does not include scores for homemakers, students, the unemployed, or the retired, scores for these individuals were initially going to be assigned based on the precedent set by Stambrook et al. (1989). Stambrook et al. assigned the following socioeconomic status scores to the above individuals: homemakers = 20.0000, retired = 15.0000, unemployed = 10.0000, and students = 5.0000. However, assigning the lowest score to individuals who were capable of being students after CHI or SCI was thought to underestimate their ability level. For this reason, students were assigned a score of 20.0000 and the other three groups had their scores reduced by 5 points from the values that Stambrook et al. had assigned.

CHAPTER III

RESULTS

Data Analyses

The data were entered onto a microcomputer database and were analyzed with the Statistical Package for the Social Sciences/PC subprograms. Because complete data were not always available for each subject, the number of subjects included in different statistical analyses sometimes varied. Results are presented in terms of tests of each hypothesis.

Hypothesis one. Hypothesis one stated that CHI patients would score worse (i.e., more impaired) than SCI patients on the KAS-R total score and the following KAS-R scales: Belligerence, Negativism, Helplessness, Suspiciousness, Withdrawal/Retardation, General Psychopathology, and Confusion. These results were expected based on the findings of Stambrook et al. (1989) who compared SCI and severe CHI patients on the KAS-R. Stambrook et al. did not utilize the Stability subscale of the KAS-R so no a priori hypothesis was offered for this scale. The data analyses for hypothesis one involved a Hotelling's T^2 test for the composite vectors of KAS-R subscores, followed by a series of univariate, one-tailed F-tests (the univariate statistic provided by

SPSS-PC). Because of the large number of comparisons between subscales, the required significance level was set at .01 for these and all subsequent univariate comparisons. The KAS-R total scores of the two groups were compared using a one-tailed *t*-test.

The results of the univariate subscale analyses of hypothesis one are presented in Table 5. The univariate and multivariate analyses partially support hypothesis one. Specifically, the difference between the mean vectors of the CHI and SCI groups was statistically significant according to Hotelling's T^2 criterion, F (13, 93) = 2.29, $p < .02$. The CHI patients were rated as more impaired than were the SCI patients. Also as hypothesized, the KAS-R total score was somewhat more impaired for the CHI patients than for the SCI patients, t (98.31) = -1.93, $p < .06$. Subscale hypotheses that were supported included the expected finding of poorer CHI than SCI performance on the General Psychopathology subscale and strong trends on the Confusion and Helplessness subscales. Also supportive of subscale hypotheses were the findings of no differences between CHI and SCI patients on the following subscales: Verbal Expansiveness, Anxiety, Nervousness, and Bizarreness. Contrary to hypothesized results, the CHI patients were rated as more impaired on the

Table 5

Performance of CHI and SCI Patients on KAS-R Subscales

Subscale	CHI	SCI	*F*
Belligerence	*M* 5.35 *SD* 1.76	*M* 5.16 *SD* 1.31	0.40
Verbal Expansiveness	*M* 6.60 *SD* 2.34	*M* 6.34 *SD* 1.73	0.40
Negativism	*M* 12.98 *SD* 3.88	*M* 12.04 *SD* 2.47	2.17
Helplessness	*M* 5.82 *SD* 1.81	*M* 5.10 *SD* 1.40	5.23*
Suspiciousness	*M* 4.86 *SD* 1.29	*M* 4.68 *SD* 1.13	0.58
Anxiety	*M* 6.82 *SD* 1.66	*M* 6.94 *SD* 1.46	0.14
Withdrawal and Retardation	*M* 10.19 *SD* 3.68	*M* 10.66 *SD* 3.64	0.43
General Psychopathology	*M* 37.39 *SD* 9.09	*M* 33.26 *SD* 6.10	7.38**
Nervousness	*M* 7.30 *SD* 2.35	*M* 7.10 *SD* 2.07	0.21
Confusion	*M* 3.72 *SD* 1.41	*M* 3.22 *SD* 0.58	5.44*
Bizarreness	*M* 5.86 *SD* 1.54	*M* 5.48 *SD* 0.86	2.38
Hyperactivity	*M* 5.47 *SD* 2.30	*M* 4.26 *SD* 1.27	10.96**
Stability	*M* 13.42 *SD* 4.02	*M* 12.84 *SD* 3.36	0.65

*$p < .05$ **$p < .01$

Hyperactivity scale and there were no differences between the groups on the Belligerence, Negativism, Suspiciousness, and Withdrawal and Retardation scales. Overall, 5 of 9 expected (multivariate and univariate) differences between the groups were obtained, while 4 of 5 expected (univariate) null results were obtained.

<u>Hypothesis two</u>. Hypothesis two stated that the CHI group would score more poorly than the SCI group on the PAIS-SR total score and the following PAIS-SR subdomains: Domestic Environment, Social Environment, Vocational Environment, and Psychological Distress. The statistical methods used to examine this hypothesis were identical to those used to test hypothesis one; namely, an Hotelling's $\underline{T}^2$ test followed by one-tailed univariate $\underline{F}$-tests, with a required statistical significance level of .01.

The results of the univariate subscale analyses are presented in Table 6. Hypothesis two was generally not supported by the univariate or multivariate results. The only hypothesized univariate outcome that was supported was a lack of a difference between the groups on Health Care Orientation. The obtained multivariate result was the opposite of that expected. Specifically, the <u>SCI</u> patients reported generally more impaired functioning than did the CHI patients according to Hotelling's $\underline{T}^2$

Table 6

Performance of CHI and SCI Patients on PAIS - SR Subscales

Subscale		CHI		SCI	F
Health Care Orientation	M	7.67	M	6.48	2.45
	SD	4.12	SD	3.02	
Vocational Environment	M	7.63	M	8.82	1.51
	SD	5.54	SD	5.14	
Domestic Environment	M	5.68	M	9.46	18.90‡
	SD	4.41	SD	4.54	
Social Environment	M	5.93	M	6.44	0.39
	SD	4.85	SD	4.32	
Psychological Distress	M	6.35	M	6.10	0.02
	SD	4.63	SD	3.72	

‡$p < .001$

criterion, F (5, 100) = 5.87, p <.001. This multivariate finding was largely due to SCI patients reporting poorer functioning on the Domestic Environment subscale and, to a much lesser extent, on the Vocational Environment subscale (see Table 6). The univariate test of the PAIS-SR total score failed to show a statistically significant difference between the groups, t (104) = 1.44, p = .15. However, as expected given the multivariate finding, the trend was towards the SCI patients reporting more impairment than the CHI patients (M = 37.3, SD = 13.8 vs. M = 32.9, SD = 17.2, respectively).

As a followup to hypotheses one and two, discriminant function analysis was used to explore which PAIS-SR and KAS-R subscale scores best separated the SCI and CHI groups. To retain an acceptable subjects to variables ratio (i.e., of more than 5 to 1; Tabachnick & Fidell, 1983) only those subscale scores (N = 11) from the above analyses that were hypothesized to differ significantly between the two groups were included as predictor variables. A direct discriminant function analysis including all predictor variables was done first. Hotelling's t-tests for the difference between two dependent correlation coefficients was then used to determine which of the PAIS-SR and KAS-R scores best separated the groups. Specifically, the strength of the most powerful predictor's correlation with the discriminant function was compared to the next most powerful predictor's correlation with the discriminant function, and so on, until a significant difference was found between two adjacent predictors (i.e., PAIS-SR and KAS-R scores). No a priori prediction was made for these analyses. Next, because it was expected that many of the KAS-R and PAIS-SR scores would be correlated with each other, a stepwise discriminant function analysis was conducted to determine the predictor variables that would contribute to discriminative power once variance associated with other variables was partialled out. Again, no a priori predictions were made for this analysis.

The results of the direct discriminant function analysis are presented in Table 7. The Domestic Environment subscale of the PAIS-SR was a better discriminator of CHI and SCI patients than was the next best variable, the General Psychopathology subscale of the KAS-R. Using Hotelling's _t_-test for the difference between two dependent correlation coefficients, this difference was statistically significant $t\ (106) = 3.03$, $p < .01$. Other than the Domestic Environment subscale of the PAIS-SR, the only variables that correlated more than

Table 7

Results of Discriminant Function Analysis of Selected KAS-R and PAIS-SR Variables

Predictor variable	Correlations of predictor variables with discriminant function	Univariate *F* (1, 104)
KAS-R Variables		
Belligerence	-.08	0.34
Negativism	-.21	1.91
Helplessness	-.33	4.68
Suspiciousness	-.10	0.45
Withdrawal/Retardation	.11	0.53
Gen. Psychopathology	-.39	6.72
Confusion	-.36	5.65
PAIS-SR Variables		
Domestic Environment	.66	18.90
Social Environment	.10	0.39
Vocational Environment	.19	1.52
Psychological Distress	-.02	0.20
Canonical R	.54	
Eigenvalue	.41	

(continued on next page)

Table 7 (continued)

Pooled within-group correlations among predictors

Predictor Variable	1	2	3	4	5	6
<u>KAS-R Variables</u>						
1. Belligerence						
2. Negativism	.60					
3. Helplessness	.32	.35				
4. Suspiciousness	.30	.38	.38			
5. Withdrawal/Ret.	.22	.27	.47	.25		
6. General Psycho.	.63	.73	.63	.45	.36	
7. Confusion	.31	.30	.37	.03	.19	.45
<u>PAIS-SR Variables</u>						
8. Vocational Env.	.22	.13	.15	.01	.47	.09
9. Domestic Env.	.13	.11	.18	.08	.32	.13
10. Social Env.	.26	.20	.31	.21	.47	.38
11. Psych. Distress	.23	.30	.45	.18	.35	.47

(continued on next page)

Table 7 (continued)

Pooled within-group correlations among predictors

Predictor Variable	7	8	9	10	11
KAS-R Variables					
7. Confusion					
PAIS-SR Variables					
8. Vocational Env.	.15				
9. Domestic Env.	-.09	.37			
10. Vocational Env.	.10	.31	.56		
11. Psych. Distress	.17	.32	.40	.50	

.21 with the discriminant function were the following subscales from the KAS-R: General Psychopathology, Confusion, and Helplessness. Overall, the discriminant function distinguished between patients and controls at a statistically significant level, with a $\underline{X}^2$ (11) = 34.19, $\underline{p}$ <.0004.

As the data in Table 7 indicate, several of the KAS-R and PAIS-SR predictor variables were correlated with each other. To determine which predictor variables would contribute to discriminative power after variance associated with other variables was partialled out, a stepwise discriminant function analysis was conducted. Table 8 indicates that the following variables contributed significantly to the stepwise discriminant function: PAIS-SR Domestic Environment, KAS-R General Psychopathology, KAS-R Helplessness, KAS-R Withdrawal and Retardation, and PAIS-SR Social Environment.

Hypothesis three. Hypothesis three stated that there would be a greater drop in socioeconomic status for premorbidly employed CHI subjects than for similarly employed SCI subjects. A $\underline{t}$-test was used to examine this hypothesis.

Hypothesis three was supported. Formerly employed CHI patients experienced a greater loss of socioeconomic status ($\underline{M}$ loss = 19.59, $\underline{SD}$ = 14.96) than did formerly

Table 8

Variables Retained in a Stepwise Discriminant Function Analysis of Selected KAS-R and PAIS-SR Variables

Predictor variable	Univariate F	df
PAIS-SR Domestic Environment	18.90	(1, 104)
KAS-R Gen. Psychopathology	16.66	(2, 103)
KAS-R Helplessness	11.88	(3, 102)
KAS-R Withdrawal/Retardation	9.19	(4, 101)
PAIS-SR Social Environment	7.75	(5, 100)

employed SCI patients (*M* loss = 10.01, *SD* = 21.64). This difference was statistically significant, *t* (62.23) = -2.18, *p* = .01.

Hypothesis four. Hypothesis four stated that the correlation between the PAIS-SR Vocational Environment scale and the difference between pre- and post-injury socioeconomic status would be stronger for the SCI group than for the CHI group. This was hypothesized because CHI subjects were thought to be less likely to accurately assess (as measured by the PAIS-SR Vocational Environment subscale) the extent to which their injury is associated with their drop in socioeconomic status.

Hypothesis four was not strongly supported. The correlation between subjective and objective assessment of loss of work ability was *r* (48) = .64, *p* <.001 for SCI patients and *r* (55) = .50, *p* <.001 for CHI patients. The difference between these two correlation coefficients was not statistically significant, according to Fisher's *Z* transformation and subsequent computation of the *z* ratio 1.04, (*p* <.15, one-tailed).

Hypothesis five. Hypothesis five examined the prediction of vocational outcome as measured by the PAIS-SR Vocational Environment scale and the post-injury socioeconomic status score. Hypothesis five consisted of two parts. Part A predicted that PTA duration, AIR score, and the two MMPI scores would contribute significant variance to the prediction of each of the two measures for the CHI group. Education level was predicted to not contribute to outcome variance as CHI-related variables were expected to overwhelm factors that may be relevant in a non-brain injured population. In contrast it was hypothesized that education level, PSI total score, and pre-injury SES would contribute significant variance to prediction of the two occupational outcome measures for the SCI group. Level of SCI lesion was not expected to contribute significant predictive variance. Two standard multiple regression analyses were used for each of the injury groups, one analysis for each of the work outcome measures.

The second part of hypothesis five was identical to the first part, with the exception that the economic disincentive variable was added as a predictor variable to determine whether it added a statistically significant amount of predictive variance over and above that accounted for in the first part of hypothesis five. Economic disincentive is actually best classified as a concurrent variable, because it quantifies the patients' current sources of income and provides a measure of how much they believe they would have to earn to make employment worthwhile. It was hypothesized that the economic disincentive score would add a statistically significant amount of predictive variance over and above that that the predictor variables in the first part of hypothesis five accounted for in both CHI and SCI groups.

The results bearing on the first part of hypothesis five are presented in Table 9. Inspection of these data indicate that the hypothesis was only partially supported. As expected, the AIR was a significant predictor of the PAIS-SR Vocational Environment subscale for the CHI patients, while premorbid education was not. Contrary to expectation, the contributions of the MMPI and PTA variables were not statistically significant. The regression equation accounted for 19% of the variance in the dependent variable, and approached statistical significance, F (5, 48) = 2.30, p <.06.

Hypothesis five was partially supported for the prediction of current socioeconomic status in the CHI group. The AIR score contributed a statistically significant amount of variance toward prediction of the current socioeconomic status score. PTA duration contributed an amount that approached statistical significance (p <.08). Unexpectedly, level of premorbid education contributed a statistically significant amount of variance while the two MMPI scores did not. The regression equation accounted for 32% of the variance in

Table 9

Prediction of PAIS-SR Vocational Environment Score and Current Socioeconomic Status

Variable	Beta	Std. Error	*t*[a]	*p*	*r*[b]
CHI Group, Prediction of PAIS-SR Vocational Env. Score					
Premorbid education	-.09	.13	-0.70	.49	-.16
MMPI 1+2+3	.18	.14	1.27	.21	.19
MMPI 4+9	-.06	.15	-0.42	.68	.11
PTA duration	.13	.14	0.91	.37	.24
AIR	.31	.15	2.12	.04	.38
CHI Group, Prediction of Current Socioeconomic Status					
Premorbid education	.26	.12	2.14	.04	.32
MMPI 1+2+3	-.03	.13	-0.19	.84	-.10
MMPI 4+9	-.09	.14	-0.63	.53	-.20
PTA duration	-.24	.13	-1.84	.07	-.37
AIR	-.29	.13	-2.16	.04	-.45
SCI Group, Prediction of PAIS-SR Vocational Env. Score					
Premorbid education	-.50	.15	-3.44	.00	-.30
Premorbid SES	.33	.15	2.22	.03	.08
Lesion level	-.32	.13	-2.46	.02	-.23
PSI total score	.20	.13	1.51	.14	.13
SCI Group, Prediction of Current Socioeconomic Status					
Premorbid education	.36	.15	2.35	.02	.30
Premorbid SES	.02	.15	0.10	.92	.14
Lesion level	.34	.14	2.49	.02	.27
PSI total score	.03	.14	0.21	.84	.04

[a]The *t*-value, and associated significance level, indicates the unique variance contributed by each variable; [b]*r* = the correlation of each predictor variable with the criterion variable.

the dependent variable, and was statistically significant, F (5, 48) = 4.59, p <.002.

For the prediction of the PAIS-SR Vocational Environment score in the SCI group, hypothesis five was only partially supported. As expected, the contributions of premorbid socioeconomic status and premorbid education were statistically significant. However, contrary to expectation, level of lesion was also a statistically significant predictor while the PSI total score was not. The regression equation accounted for 28% of the variance in the dependent variable, and was statistically significant, F (4, 45) = 4.29, p <.006.

Hypothesis five was only weakly supported for the prediction of current socioeconomic status in the SCI group. As expected, the contribution of premorbid education was statistically significant. However, contrary to expectation, lesion level was a statistically significant predictor while the PSI total score and premorbid socioeconomic status were not. The regression equation accounted for 20% of the variance in the dependent variable and was statistically significant, F (4, 45) = 2.85, p <.03.

The second part of hypothesis five stated that the economic disincentive variable would add a statistically significant amount of predictive variance over and above that contributed by the variables in the first part of hypothesis five for both CHI and SCI groups. The results obtained generally support the second part of hypothesis five.

Hypothesis five was supported for the prediction of the PAIS-SR Vocational Environment score in the CHI group. The economic disincentive score accounted for an additional 16% of variance in the prediction of the dependent variable. This contribution was statistically significant, F (1, 41) = 10.38, p <.003.

Hypothesis five was supported for the prediction of current socioeconomic status in the CHI group. The economic disincentive score accounted for an additional 18% of variance in the prediction of the dependent variable. This contribution was statistically significant, F (1, 41) = 15.59, p <.0004.

Hypothesis five was supported for the prediction of the PAIS-SR Vocational Environment score in the SCI group. The economic disincentive score accounted for an additional 8% of variance in the prediction of the dependent variable. This contribution was statistically significant, F (1, 39) = 4.75, p <.04.

Hypothesis five was supported for the prediction of current socioeconomic status in the SCI group. The economic disincentive score accounted for an additional

16% of variance in the prediction of the dependent variable. This contribution was statistically significant, F (1, 39) = 8.51, p <.006.

Hypothesis six. Hypothesis six was based on previous research that suggests personality score differences between subjects who are "active" agents in their accidents (i.e., are imprudent) and those who are "passive" agents in their accidents (i.e., are non-imprudent).

The records of all patients were examined to derive imprudent and nonimprudent subgroups within each of the SCI and CHI groups. For SCI, imprudent behaviors included diving head first into very shallow water, being intoxicated while driving, or involvement in similar events that demonstrated imprudence. "Nonimprudent" SCI patients had documentation indicating they did not suffer their injuries as the result of diving head first into very shallow water and that they were "innocent" victims in their accident. Such instances included being a passenger in vehicle that was involved in a motor vehicle accident, or being awarded money from a lawsuit that implicated another party. Similar criteria were used to classify CHI patients into subgroups. Cases that did not clearly fall into either group were excluded from the analyses. Table 10 provides a breakdown of subjects into

Table 10

Types of Accidents that Imprudent, Nonimprudent, and Unclassified Subjects Were Involved in

Accident type	_N_ of CHI	_N_ of SCI
Imprudent		
Diving into very shallow water	0	12
At fault in MVA	5	1
Driving while intoxicated	3	2
Driving motorcycle helmetless	2	1
Diving into shallow water/intoxicated	0	2
Fall while intoxicated	0	2
At fault in snowmobile accident	1	0
Drove car into a tree at 140 km/hr	1	0
Fall from moving van after hanging onto the outside of it and arguing with driver	0	1
Nonimprudent		
Passenger in MVA	7	4
Not at fault in motorcycle accident	2	0
Other party at fault in car accident	3	1
Fall when dizzy (not intoxicated)	1	1
Industrial accident	1	3
Tire on car blew out	0	1
Brick fell on neck at worksite	0	1
Passenger on motorcycle	1	0
Fall at work	2	0
Assistant error while hang-gliding	1	0
Mugged	1	0
Unclassified		
Unspecified MVA	17	10
Unspecified motorcycle accident	4	4
Unspecified car/pedestrian accident	3	0
Unspecified sports injury	0	2
Fall down stairs	0	1
Unspecified car/bicycle accident	1	0
Unspecified fall	1	1

groups according to imprudent action, nonimprudent action, and subjects not easily classified.

For the CHI patients it was predicted that imprudent subjects would score worse than nonimprudent subjects on the total score of the PSI, higher on scale 4 of the MMPI, lower on scale 5 of the MMPI (if male), and higher on the difference between scales 4 and 3 (i.e., 4 minus 3). These have all been suggested to be measures of "acting out" or poor problem solving/judgement (Heppner & Peterson, 1988; Graham, 1987). A Hotelling's $\underline{T}^2$ test, followed by one-tailed $\underline{t}$-tests, were used to test this hypothesis.

Next, imprudent and nonimprudent CHI subjects were compared to imprudent and nonimprudent SCI subjects on the PSI total score using a two-way (injury-type by imprudent/nonimprudent) analysis of variance. It was hypothesized that there would be a main effect for imprudent/nonimprudent, but not for injury type.

Multivariate analysis of the MMPI and PSI scores of imprudent and nonimprudent CHI patients did not produce a statistically significant result according to Hotelling's $\underline{T}^2$ criterion $\underline{F}$ (4, 17) = 0.82, $\underline{p}$ = .53. The multivariate analysis only included male CHI patients as MMPI scale 5 results only hold for men (the scale is reversed for women). The univariate comparisons for CHI patients (both male and female, excluding the MMPI scale 5 comparison) are presented in Table 11. The only univariate comparison that approached significance was on the variable created by subtracting MMPI scale 3 from MMPI scale 4 (p <.09).

Results of the two-way (imprudent/nonimprudent by CHI/SCI) ANOVA for the PSI total score are presented in Table 12. The hypothesized main effect for impudent/nonimprudent behavior was not statistically significant. Contrary to expectation there was a trend toward a main effect for injury, with the CHI patients obtaining poorer (i.e., higher) scores than the SCI patients. There was no interaction effect.

Hypothesis seven. Hypothesis seven simply stated that, consistent with previous research, the imprudent group would have been younger than the nonimprudent group at the time of injury. A one-tailed t - test was used to examine this hypothesis.

Hypothesis seven was partially supported. The imprudent group's mean age at the time of injury was younger than that of the nonimprudent group (M = 23.42 (SD = 6.70) and M = 28.93 (SD = 11.98), respectively). This difference approached statistical significance, t(44.57) = -2.22, p <.04.

A summary of the hypothesized and obtained

Table 11

Univariate Comparisons of Imprudent and Nonimprudent CHI Subjects on Selected Variables

Variable	Imprudent Group	Nonimprudent Group	*t*
M PSI Total Score	86.67	93.95	-0.61
SD	23.74	36.36	
M MMPI Scale 4	62.83	61.21	0.73
SD	12.19	12.57	
M MMPI Scale 4 minus Scale 3	4.40	-4.37	1.78
SD	10.93	13.71	
M MMPI Scale 5 (Males only)	51.09	54.82	-0.99
SD	9.48	8.21	

None of the comparisons attained statistical significance (i.e., $p < .01$, one-tailed).

Table 12

Two-way Analysis of Variance of PSI Total Scores for Imprudent/Nonimprudent Behavior by Injury Group

Source	*df*	*SS*	*MS*	*F*	*p*
Imprudent/ Nonimprudent	1	1353.04	1353.04	1.65	.20
Injury (CHI/SCI)	1	2529.27	2529.27	3.08	.08
Interaction	1	82.33	82.33	0.10	.75
Error	59	48415.60	820.60		
Total	62	53758.98	867.08		

results is presented in Table 13. The table indicates that hypotheses regarding the KAS-R and socioeconomic status received at least partial support while hypotheses regarding the PAIS-SR and imprudent/nonimprudent distinctions received little, if any, support.

Table 13

Summary of the Results

Hypothesis one. CHI patients would score worse than SCI patients on the KAS-R total score and the Belligerence, Negativism, Helplessness, Suspiciousness, Withdrawal/Retardation, General Psychopathology, and Confusion scales.

Hypothesis one results. CHI patients scored worse than SCI patients on the KAS-R total score, the Helplessness scale, the Confusion scale (all $p < .05$), the General Psychopathology Scale ($p < .01$), and the Hyperactivity scale ($p < .01$).

Hypothesis two. CHI patients would score worse than SCI patients on the PAIS-SR total score and the Domestic Environment, Social Environment, Vocational Environment, and Psychological Distress scales.

Hypothesis two results. SCI patients scored worse than CHI patients on the PAIS-SR Domestic Environment scale ($p < .001$).

Exploratory analysis. Direct discriminant function analysis demonstrated that of the KAS-R and PAIS-SR variables that were expected to differ between CHI and SCI groups, the PAIS-SR Domestic Environment scale was the best discriminating variable.

Hypothesis three. There would be a greater drop in socioeconomic status for premorbidly employed CHI subjects than for similarly employed SCI subjects.

Hypothesis three results. Premorbidly employed CHI patients experienced a greater loss of socioeconomic status than did similarly employed SCI subjects ($p = .01$).

Hypothesis four. The correlation between the PAIS-SR Vocational Environment scale and the difference between pre- and post-injury socioeconomic status would be stronger for the SCI group than for the CHI group.

Hypothesis four results. There was a weak trend ($p < .15$) in the anticipated direction.

(continued on next page)

Table 13 (continued)

Hypothesis five (A). PTA duration, AIR score, and the two MMPI scores would contribute significant variance to the prediction of current socioeconomic status and the PAIS-SR Vocational Environment score in the CHI group. Premorbid education level would not contribute significant variance.

Premorbid education level, PSI total score, and premorbid socioeconomic status would contribute significant variance to the prediction of current socioeconomic status and the PAIS-SR Vocational Environment score in the SCI group. Level of SCI lesion would not contribute significant variance.

Hypothesis five (A) results. PTA duration (p <.08), AIR score (p <.05), and premorbid education level (p <.05) contributed variance to the prediction of current socioeconomic status in the CHI group.

Only the AIR score (p <.05) contributed significant variance to the prediction of the PAIS-SR Vocational Environment score in the CHI group.

Premorbid education level (p <.03) and level of SCI lesion (p <.03) contributed significant variance to prediction of current socioeconomic status in the SCI group.

Premorbid education level (p <.01), premorbid socioeconomic status (p <.04), and level of SCI lesion (p <.03) contributed variance to prediction of the PAIS-SR Vocational Environment score in the SCI group.

Hypothesis five (B). The economic disincentive score would add a statistically significant amount of predictive variance over and above that contributed by the predictor variables in Hypothesis five (A) for both the CHI and SCI groups.

Hypothesis five (B) results. The economic disincentive score added a statistically significant amount of extra predictive variance for both the CHI and SCI groups.

Hypothesis six. In the CHI group, imprudent subjects would score worse than nonimprudent subjects on

(continued on next page)

Table 13 (continued)

the PSI total score, higher on scale 4 of the MMPI, lower on scale 5 of the MMPI (if male), and higher on the difference between scales 4 and 3 (i.e., 4 minus 3).

Using a two-way analysis of variance to analyze PSI total score, there would be a main effect for imprudent/nonimprudent, but not for injury type.

Hypothesis six results. In the CHI group, only on the difference between MMPI scales 4 and 3 was there even weak support ($p < .09$) in the anticipated direction.

In the two-way analysis of variance, there was a trend towards a main effect for injury type ($p < .09$), with CHI patients scoring worse.

Hypothesis seven. The imprudent group would have been younger than the nonimprudent group at the time of injury.

Hypothesis seven results. There was a trend ($p < .04$) for the imprudent group to have been younger at the time of injury.

CHAPTER IV

DISCUSSION

Before the results of this study are discussed several points with regard to subject and procedural characteristics should be made. First, both the CHI and SCI patients in this study suffered severe to very severe injury and were contacted a minimum of two years after their injury. The results of this study may not necessarily be generalizable to individuals with less severe injury and/or those for whom less time has passed since injury. The CHI patients all had PTA of at least one week and had been seen for rehabilitation purposes at Chedoke-McMaster Hospitals. Similarly, all SCI patients had been seen for rehabilitation purposes at Chedoke-McMaster Hospitals. In addition to being seen for rehabilitation purposes, SCI severity was ensured by the criterion that all SCI patients required assistive devices for ambulation (the vast majority were wheelchair-bound). On the other hand, for conceptual reasons, only SCI patients who had no evidence of brain-injury were included in the present study. Because approximately 50% of SCI victims are believed to suffer a concurrent brain-injury (Davidoff et al., 1988), the present results may not be generalizable to the many individuals who suffer SCI and CHI concurrently.

Second, the possibility of a sampling bias must be addressed. Specifically, do the participants in the present study differ from non-participants in systematic ways that limit generalization of the present results? The limited data that are available for non-participants indicate that they do not differ much from participants. For the CHI non-participants and participants the mean PTA duration was 59.43 and 62.75 days, respectively; the mean AIR score was 2.53 and 2.51, respectively; the mean number of years of education was 11.15 and 11.89, respectively; the mean age injury was 30 years and 26 years, respectively; the proportion of males was 86% and 81%, respectively; and the majority in each group were injured in motor vehicle accidents. For the SCI non-participants and participants, the mean SCI lesion scores were 5.38 and 4.20, respectively; the mean age at injury was 26 years and 25 years, respectively; the proportion of males was 77% and 82%, respectively; and the most frequent single cause of injury in each group was motor vehicle accidents. The above data indicate no large differences between participants and non-participants. However, the CHI participants were perhaps slightly younger and better educated than non-participants while

SCI participants had slightly higher level spinal injuries than did non-participants. To the extent that these differences are pertinent, they suggest that the poorer performances by CHI than SCI patients in the present study are reliable. This is because a possibly "better off" CHI group was compared with a possibly "worse off" SCI group. There is another reason to expect that the CHI patients in the present study are a "better off" severe CHI group. Numerous very severely involved CHI patients undoubtedly go directly into extended care facilities after the acute care phase, and are never seen at a rehabilitation centre. Such patients would not have been included in the present sample.

Third, there was considerable variability in the time-span after injury at which the CHI group received their neuropsychological assessments though all were tested within two years of PTA termination. Some research (e.g., Donaghy, 1988) suggests that later assessment is a better predictor of psychosocial functioning than is earlier assessment.

Fourth, the measure of injury severity in the CHI group (i.e., retrospective PTA) is one of the more unreliable measures of injury severity. Nevertheless, it was the measure utilized in the present study because it was by far the most available measure of injury severity. A more reliable severity measure may have possibly changed the outcome of certain analyses in this study.

Fifth, some of the multivariate analyses in this study had a subjects to variables ratio of less than ten to one. Although a ratio of as low as five to one is an acceptable minimum for exploratory work (Tabachnick & Fidell, 1983), replication of the previously unexplored findings of this study is essential.

Discussion of results is divided into nine sections. The first eight sections address the findings of data analyses associated with each hypothesis. The final section outlines the primary contributions of this study and provides suggestions for future research.

Hypothesis one

Hypothesis one stated that CHI patients would score worse (i.e., more impaired) than SCI patients on the KAS-R total score and the Belligerence, Negativism, Helplessness, Suspiciousness, Withdrawal/Retardation, General Psychopathology, and Confusion scales. No differences were anticipated on the Verbal Expansiveness, Anxiety, Nervousness, Bizarreness, or Hyperactivity scales. These results were expected based on the findings of Stambrook et al. (1989) who compared SCI and severe CHI patients on the KAS-R. Stambrook et al. did not utilize the Stability subscale of the KAS-R so no a priori hypothesis was offered for this scale.

Hypothesis one was partially supported. As anticipated, the CHI patients scored worse on the General Psychopathology subscale and showed strong trends towards poorer scores on the Helplessness and Confusion scales. Also supportive of hypothesis one were the findings of no differences between CHI and SCI patients on the Verbal Expansiveness, Anxiety, Nervousness, and Bizarreness scales.

Contrary to hypothesis one, there were no differences between the groups on the Belligerence, Negativism, Suspiciousness, and Withdrawal/Retardation scales. Also contrary to the hypothesis was the finding that CHI patients scored worse on the Hyperactivity scale of the KAS-R. Stambrook et al. (1989) did not find the latter difference between their SCI and CHI groups. There was no a priori hypothesis for the KAS-R Stability scale. No difference was found on this scale between CHI and SCI groups in the present study. The discussion of hypothesis one begins with results that replicated those of Stambrook et al. and is followed by a discussion of findings that failed to replicate those of Stambrook et al. Throughout the discussion reference is also made to other relevant research.

The three KAS-R scales that differed between CHI and SCI patients in both the Stambrook et al. (1989) study and the present study were Helplessness, General Psychopathology, and Confusion. It is important to note that items on these three scales tap heavily into the cognitive deficits commonly seen after severe CHI, even though the KAS-R was originally designed to assess adjustment and social behavior in psychiatric patients. The Confusion scale consists exclusively of items associated with memory and temporal-spatial disorientation. Two of the four items on the Helplessness scale also address cognitive difficulties (i.e., concentration and decision-making problems). The other two items on the Helplessness scale deal with acting helplessly and crying easily. Finally, the General Psychopathology Scale includes items relevant to the cognitive deficits seen after severe CHI. These include items addressing confusion and saying the same things over and over again (i.e., perseveration). The General Psychopathology scale also taps into emotional instability commonly found after head injury, such as laughing or crying at strange times or being easily annoyed.

The aforementioned cognitive difficulties have been reported numerous times in previous long-term CHI outcome studies (e.g., Prigatano et al., 1984; Van Zomeren & Van Den Berg, 1985; Weddell et al., 1980). The same may be said for the emotional difficulties outlined above (e.g., Bruckner & Randle, 1972; Gilchrist & Wilkinson, 1979; Weddell et al., 1980). The present study found such difficulties to be more common in CHI patients than in patients with SCI, another long-term chronic disabling condition that did not involve brain-injury . For this reason, it is reasonable to conclude that the elevations that CHI patients show on the Confusion, Helplessness, and General Psychopathology scales are associated with brain-dysfunction and are not necessarily correlates of chronic long-term disability. The argument that these phenomena are not correlates of chronic long-term disability is bolstered by the finding that SCI patients' scores did not differ from scores of age-equated normals (Hogarty & Katz, 1971) In contrast, CHI patients' scores did differ from the age-based norms.

The KAS-R scales that did not differentiate CHI and SCI individuals in either the Stambrook et al., (1989) study or the present study were Verbal Expansiveness, Anxiety, Nervousness, and Bizarreness. Ratings of both the CHI and SCI patients on the first three of these scales also did not differ from age-based norms supplied by Hogarty and Katz (1971). However, CHI patients were rated higher on the Bizarreness scale that were normals (Hogarty & Katz, 1971). The Bizarreness scale consists largely of items related to delusions, hallucinations, and "strange behavior." Although psychoses sometimes appear after very severe head injury (e.g., Thomsen, 1984), psychotic behavior did not occur at a sufficiently high rate in the present CHI subjects to differentiate them from SCI subjects. That CHI patients scored hihger than age-based norms may be due to CHI patients exhibiting more unusual behavior than normals do. Conversely, it may be an artifact because it is not possible to determine if KAS-R informants and/or subjects differed in ways other than age between the present study and the Hogarty and Katz (1971) study.

The Verbal Expansiveness scale largely consists of items that deal with talking too loudly or too much. Previous studies (e.g., Newton & Johnson, 1986) have indicated that such behavior is sometimes found after CHI to a degree greater than it is found in normal controls. However, the fact that the incidence of this behavior was found at a rate no greater in CHI than well-matched SCI patients suggests that brain injury may not be the only reason for its occurrence. Other reasons could include premorbid existence of such behavior, the frustration associated with a chronic disabling condition, or a combination of these two and/or other factors.

The final two scales on which neither the Stambrook et al. (1989) study nor the present study found differences were the Anxiety and Nervousness scales. In addition, neither the CHI nor the SCI group in the present study differed on these scales when compared to age-based norms supplied by Hogarty and Katz (1971). These results suggest that the commonly reported existence of such phenomena after CHI (Cartlidge et al., 1981; Lewin et al., 1979; Oddy et al., 1985) is not necessarily the result of brain-injury, per se. Instead, it may be associated with premorbid characteristics (e.g., Cartlidge et al., 1981). It is theoretically possible that anxiety after CHI represents solely a psychological reaction to stressful personal or environmental situations associated with a chronic disability. However, this is relatively unlikely because the present study and previous studies (e.g., Klonoff et al., 1986) have consistently found that CHI and SCI patients do not differ from normals (Hogarty & Katz, 1971) on the Anxiety and Nervousness scales.

Four scales on which Stambrook et al. (1989) found a difference between CHI and SCI groups were not found to differ in the present study. These scales were Belligerence, Negativism, Suspiciousness, and

Withdrawal/Retardation. The scales tap into emotional behavior, whereas the three scales on which differences were found in both studies more extensively inquire about cognitive deficits. A key difference between the Stambrook et al. (1989) study and the present study was that the former study had wives rate their husband's behavior, whereas the present study had any of a variety of friends/relatives rate the patient's behavior. Only one-quarter of the informants in the present study were spouses. Spouses may be disproportionately affected by their partner's CHI (Brooks, 1984). They also likely spend more time with the CHI person than do other relatives or friends. They may more often be exposed to "emotional" behavior when the CHI patient puts his "social facade" aside at home. This may explain why spouses' ratings in the Stambrook et al. (1989) study showed more differences between CHI and SCI patients than did ratings by a variety of relatives and friends in the present study. Unfortunately, it is difficult to properly compare the findings on the four aforementioned scales to the norms provided by Hogarty and Katz (1971), as the latter authors did not provide a breakdown of the informants' relationship to the subject rated.

The present study found CHI patients to be rated worse than SCI patients on the KAS-R Hyperactivity scale.

Stambrook et al.'s (1989) findings on this scale did not achieve statistical significance though they were of similar magnitude and in the same direction. Stambrook et al.'s findings likely did not attain statistical significance because of a smaller sample size (N = 41) than that utilized in the present study (N = 107).

The KAS-R Hyperactivity scale taps into behavior commonly reported after head injury. Such behaviors include "did the same thing over and over again without reason," (e.g., perseveration) and "was restless" (e.g., couldn't maintain concentration for an extended period of time). Thus, it may be said that the items tapped by the KAS-R Hyperactivity scale are relatively more influenced by brain injury than by long-term chronic disability associated with a condition such as SCI. It is unlikely that CHI patients performed worse than SCI patients on the KAS-R Hyperactivity scale merely because the SCI patients were less physically mobile. This is because SCI patients' Hyperactivity scores in the present study did not differ from those of age-equated normals (Hogarty & Katz, 1971).

In conclusion, the results of the data analyses associated with hypothesis one suggest that many of the cognitive problems (e.g., concentration/memory difficulties, confusion, perseveration) and emotional difficulties (e.g., lability) commonly reported after severe CHI are indeed associated with brain-injury and are not just effects of a chronic disabling condition. In contrast, other findings that have been reported after CHI (e.g., anxiety and verbal expansiveness) are found just as commonly in normal age-peers and in SCI patients. Such behaviors may thus often be associated with premorbid characteristics. Results that are inconsistent with previous comparisons of CHI and SCI patients (e.g., Stambrook et al., 1989) may be due to CHI patients exhibiting several "emotional" behaviors (e.g., belligerence, negativism) more commonly around spouses than other relatives/friends. Finally, the absence of greater psychotic symptomatology in the CHI group than the SCI group indicates that such behavior may occur only very infrequently after CHI and/or that psychotic individuals failed to participate in the present study.

Hypothesis two

Hypothesis two stated that the CHI patients would rate themselves more poorly than SCI patients on the PAIS-SR total score and the Psychological Distress, Domestic Environment, Social Environment, and Vocational Environment subscores. The differences anticipated on the first three subscale scores were expected given the extensive literature that documents such difficulties after CHI. The difference on the Vocational Environment subscore was expected based on the trend reported by Stambrook et al. (1989) of poorer self-ratings by CHI patients than SCI patients on the "Work" scale of the Sickness Impact Profile. There was no a priori reason to expect a difference between groups on the Health Care Orientation scale of the PAIS-SR.

The only finding that supported hypothesis two was the lack of a difference on the Health Care Orientation scale of the PAIS-SR. There were also no differences between groups on any of the other PAIS-SR measures except the Domestic Environment scale. The difference on the latter scale went in the direction opposite that predicted, with SCI patients reporting poorer functioning than CHI patients.

The lack of a difference between groups on the Psychological Distress subscale of the PAIS-SR is consistent with Stambrook et al.'s (1989) findings of no difference between SCI and CHI groups on the Emotional Behavior scale of the Sickness Impact Profile. However, the lack of a difference between groups is not consistent with KAS-R differences between groups noted by relatives in both studies. The lack of difference between groups is also not consistent with literature (Thomsen, 1984; Van Zomeren & Van Den Berg, 1984; Weddell et al., 1980) that has reported impaired emotional functioning in the long-term after CHI but relatively intact emotional functioning in the long-term after SCI (Bourestrom & Howard, 1965; Decker & Schulz, 1985).

The lack of self-reported differences between groups on the PAIS-SR Psychological Distress scale in the present study occurred for at least two reasons. First, CHI patients did not admit to any more difficulties than did SCI patients on the three items that deal with areas consistently reported to be troublesome after CHI (i.e., depression and/or irritability). On each of these three items the CHI and SCI groups reported presence/absence of symptoms at an incidence rate of within 4% of the other group. This finding is consistent with literature (e.g., McKinlay & Brooks, 1984) that indicates CHI patients are particularly unlikely to report emotional symptoms that relatives notice in them. In addition, the lack of admission of difficulties is more common with more severe injuries (Wild et al., 1985; Weinstein & Lyerly, 1968). Lack of admission of difficulties is a distinct possibility given the marked severity of injury suffered by the CHI patients in the present study.

The CHI patients' mean scores on the MMPI validity scales were not strongly suggestive of an attempt to "fake good." The mean scores were: scale L = 55.02, scale F = 62.44, and scale K = 55.84. However, these scores do not necessarily mean that the CHI patients were answering PAIS-SR Psychological Distress scale items in an "objectively" valid way. The PAIS-SR items (see Appendix C) appear to be more face-valid than are the MMPI validity scale items and may be more susceptible to response biases. In addition, the MMPI validity scales have not been extensively investigated vis-a-vis their relationship to organically-based unawareness. It would be premature to discard the considerable evidence that does exist regarding unawareness of difficulties after CHI in favor of MMPI scores that were developed in a different context and with different populations.

There is a second reason for the lack of difference between CHI and SCI groups on the PAIS-SR Psychological Distress scale. Two of the scale's seven items deal with anxiety and worry, a phenomenon that did not differ between CHI and SCI patients, as rated by relatives on the KAS-R. In addition, one PAIS-SR Psychological Distress item asks about reduction in physical attractiveness. Post-hoc analysis indicated that the latter item was endorsed more commonly by SCI patients. Seventy-two percent of SCI patients indicated that they felt at least somewhat less physically attractive whereas only 40% of the CHI patients responded similarly. As one

SCI patient stated, "It is hard not to feel less attractive when you go from being six foot-four to being four foot-six."

The lack of a difference between the CHI and SCI groups on the PAIS-SR Psychological Distress Scale was not due to a ceiling effect. Both groups' mean scores were approximately 6, with the maximum possible score being 21.

In conclusion, the lack of a difference between CHI and SCI patients on the Psychological Distress Scale of the PAIS-SR was most likely due to a lack of admission of difficulties by CHI patients on items dealing with depression and/or irritability. In addition, an item asking about a reduction in physical attractiveness was actually endorsed more often by SCI than CHI patients.

The lack of difference between CHI and SCI groups on the Social Environment subscale of the PAIS-SR is at odds with the literature (Fordyce et al., 1983; Thomsen, 1984) that has reported social isolation and loneliness in the long-term after CHI. In addition, a study of Israeli war veterans (Rosenbaum & Najenson, 1976) found that wives of head injured veterans reported them to be more socially handicapped and deserted by old friends than were SCI veterans. However, the lack of a difference in the present study is consistent with

Stambrook et al.'s (1989) findings of no self-reported differences between groups on the Social Interaction and Recreation/Past-times scales of the Sickness Impact Profile.

The lack of difference between groups in both studies may have been due to the CHI group's lack of admission of social difficulties. In the present study the lack of a difference between groups may also have been due to parents doing more with the CHI patient to help make up for a lack of friends. Increased parental involvement to make up for lack of socialization with friends after CHI was previously reported by Weddell et al. (1980). A final and not mutually exclusive possibility is that SCI patients also suffer some degree of social isolation, given their marked physical handicap and the stigma associated with it. The lack of difference between CHI and SCI groups was not due to a ceiling effect as the groups mean scores were approximately 6, out of a maximum possible score of 18.

The lack of difference between CHI and SCI groups on the PAIS-SR Vocational Environment scale is not consistent with the present study's finding of a much larger drop in socioeconomic status for CHI than SCI patients. It is also not consistent with Stambrook et al.'s (1989) finding of a trend towards greater self-reported impairment by CHI patients than SCI patients on the "Work" scale of the Sickness Impact Profile.

Undoubtedly, a large part of the reason for the lack of self-reported difference between CHI and SCI groups on the PAIS-SR Vocational Environment scale is the subjective nature of the questions on the scale. The questions do not ask whether the patient is employed, as the "Work" scale of the Sickness Impact Profile does. Rather, the questions inquire as to the degree to which the patient believes that work ability is and has been impaired. The lack of admission of difficulties after CHI has been well documented (e.g., McKinlay & Brooks, 1984). Lack of admission of difficulties has been found particularly often after very severe CHI (Weinstein & Lyerly, 1968; Wild et al., 1985). Such a severity description fits the present CHI patients very accurately.

Perhaps the most unexpected finding on the PAIS-SR was that SCI patients rated themselves as significantly more impaired on the Domestic Environment scale than did CHI patients. This finding appears to have been the result of scale items that inquired about <u>physical</u> limitations. The SCI patients in the present study were considerably less mobile than were the CHI patients. The importance of physical factors in accounting for the difference between CHI and SCI groups on the Domestic Environment scale was supported by post-hoc analyses. Table 14 presents a breakdown of responses to each of the eight items on the PAIS-SR Domestic Environment scale. Items 7 and 3 inquire about physical and presumably physical limitations, respectively. It was on these two items that SCI patients endorsed far more impairment than did CHI patients. In addition, within the SCI group there was a statistically significant correlation between the lesion level and PAIS-SR Domestic Environment score, $\underline{r}$ (48) = -.34, $\underline{p}$ <.01. SCI patients with higher lesions tended to report greater impairment on the PAIS-SR Domestic Environment scale.

The differences between the SCI and CHI groups' responses were relatively minor on most non-physical items of the Domestic Environment scale. To the extent that there were slight differences on such items SCI patients tended to endorse more difficulties than did CHI patients. This is evident on items 1 and 2, which ask about the quality of relationships with cohabitants. In contrast, reports of far more interpersonal difficulties with family members of the CHI patients would have been expected based on relatives' reports (e.g., Lewin & Roberts, 1979; Van Zomeren & Van Den Berg, 1980; Stambrook et al., 1989). Once again, CHI patients may

Table 14

Responses of CHI and SCI Patients to PAIS-SR Domestic Environment Items

1) How would you describe your relationship with your husband or wife (partner, if not married) since your illness?

	CHI	SCI
a) Good	59%	42%
b) Fair	21%	34%
c) Poor	11%	14%
d) Very Poor	9%	10%

2) How would you describe your general relationships with the other people you live with (e.g., children, parents, aunts, etc.)?

	CHI	SCI
a) Very poor	0%	4%
b) Poor	4%	10%
c) Fair	30%	24%
d) Good	66%	62%

3) How much has your illness interfered with your work and duties around the house?

	CHI	SCI
a) Not at all	45%	2%
b) Slight problems, easily overcome	25%	14%
c) Moderate problems, not all of which can be overcome	16%	46%
d) Severe difficulties with household duties	14%	38%

4) In those areas where your illness has caused problems with your household work, how has the family shifted duties to help you out?

	CHI	SCI
a) The family has not been able to help out at all	2%	14%
b) The family has tried to help but many things are left undone	2%	12%
c) The family has done well except for	23%	28%

a few minor things

d) No problems	73%	46%

5) Has your illness resulted in a decrease in communication between you and members of you family?

	CHI	SCI
a) No decrease in communication	61%	64%
b) A slight decrease in communication	14%	18%
c) Communication has decreased, and I feel somewhat withdrawn from them	13%	8%
d) Communication has decreased alot, and I feel very alone	13%	10%

6) Some people with an illness like yours feel they need help from other people (friends, neighbors, family etc.) to get things done from day to day. Do you feel you need such help and is there anyone to provide it?

	CHI	SCI
a) I really need help but seldom is anyone around to help	0%	2%
b) I get some help, but I can't count on it all of the time	9%	14%
c) I don't get all the help I need all of the time, but most of the time help is available when I need it	21%	42%
d) I don't feel I need such help, or the help I need is available from my family or friends	70%	42%

7) Have you experienced any physical disability with your illness?

	CHI	SCI
a) No physical disability	29%	0%
b) A slight physical disability	29%	8%
c) A moderate physical disability	20%	12%
d) A severe physical disability	23%	80%

8) An illness such as yours can sometimes cause a drain on the family's finances; are you having any difficulties meeting the financial demands of your illness?

	CHI	SCI
a) Severe financial hardship	7%	6%
b) Moderate financial hardship	18%	20%
c) A slight financial drain	16%	38%
d) No money problems	60%	36%

not have been aware of or not admitted such difficulties (McKinlay & Brooks, 1984; Van Zomeren & Van Den Berg, 1980).

In conclusion, results of the data analyses associated with hypothesis two suggest that the subjective, self-rating nature of the questions on the PAIS-SR was largely responsible for the lack of differences between groups. Such a conclusion is supported by relatives' ratings of CHI patients as worse than SCI patients on several scales of the KAS-R. The CHI patients' tendency to be unaware of, or deny emotional and interpersonal difficulties that others may notice led to less impaired scores on many items. In addition, post-hoc analyses indicated that the marked physical limitations of SCI patients played a role in their poorer score on the Domestic Environment scale of the PAIS-SR. Overall though, the lack of concordance of CHI patients' PAIS-SR results with relatives' reports and with objective data (e.g., drop in socioeconomic status) warns of the dangers of relying exclusively on CHI patients' opinions of the nature and degree of their deficits.

As a followup to hypotheses one and two, discriminant function analysis was used to explore which PAIS-SR and KAS-R scales best separated the SCI and CHI groups. The scales ($\underline{N}$ = 11) that were anticipated to differ between the CHI and SCI groups were included as possible predictor variables. There were no a priori hypotheses offered for which scales would best separate the two groups. First, a direct discriminant function analysis was conducted. Then a stepwise discriminant function analysis was conducted to determine the variables that would contribute predictive variance once variance associated with other variables was partialled out.

The results of the direct discriminant function analysis largely reiterated the group comparison findings of hypotheses one and two. Specifically, the only variables that correlated more than .21 with the discriminant function were the PAIS-SR Domestic Environment scale, the KAS-R General Psychopathology scale, the KAS-R Confusion scale, and the KAS-R Helplessness scale. These scales were the only ones to differ between the CHI and SCI groups in the univariate comparisons discussed above.

Of more interest is the fact that the PAIS-SR Domestic Environment subscale's correlation ($\underline{r}$ = .66) with the discriminant function was statistically stronger than that of the next most important variable, the KAS-R General Psychopathology scale ($\underline{r}$ = -.39). The physical impairment items on the PAIS-SR Domestic Environment scale undoubtedly played a large part in SCI patients obtaining a more impaired score on this scale. The gist of these results is that the single-most useful way to separate CHI and SCI patients was on the basis of physical impairment reported by SCI patients on the Domestic Environment scale of the PAIS-SR.

This finding of particularly obvious physical differences between SCI and CHI patients speaks to the issue of the relatively "hidden impairments" of the CHI patient. Because most of the CHI patients in the present study can "walk and talk" they may at first glance be taken as more intact than are wheelchair-bound SCI patients. They may be given less support and tolerance by the general public, because of their lack of obvious physical disability (Jennett et al., 1981). This is despite the fact that the personality changes that occur after head injury cause much more distress to the patient's family than do physical changes (Lewin & Roberts, 1979). The need for public education of the marked difficulties experienced by CHI patients and their families is underscored by the present findings.

The results of the stepwise discriminant function analysis largely reiterated those associated with the direct discriminant function analysis. Specifically, the first three variables retained in the stepwise analysis were also three of the four variables that were most strongly correlated with the direct discriminant function. These three variables were the PAIS-SR Domestic Environment scale, the KAS-R General Psychopathology scale, and the KAS-R Helplessness scale. Undoubtedly, the fourth KAS-R variable (i.e., the Confusion scale) that was correlated with the direct discriminant function was not retained in the stepwise analysis because of its correlations (_rs_ = .45 and .37) with the other two KAS-R scales that were entered into the analyses first. The two KAS-R variables that were entered first (i.e., General Psychopathology and Helplessness) took enough of the variance shared with the KAS-R Confusion scale with them into the discriminant function that the Confusion scale was not left with enough predictive variance to be entered.

The importance of the first three variables entered into the stepwise discriminant function analysis have been discussed above. The contribution of physical factors to the PAIS-SR Domestic Environment score for SCI patients, and the contribution of commonly reported cognitive and emotional factors to the KAS-R General Psychopathology and Helplessness scores for CHI patients need not be reiterated here.

The unique contribution of the stepwise discriminant function analysis was that the KAS-R Withdrawal/Retardation scale and the PAIS-SR Social Environment scale were retained as contributing significant predictive variance. These variables did not differ between groups in the group comparisons associated with hypotheses one and two. However, the KAS-R Withdrawal/Retardation scale and PAIS-SR Social Environment scales were able to help separate the CHI and SCI groups when variance associated with the first three variables entered into the analyses was partialled out.

The ability of poorer KAS-R Withdrawal/Retardation scores in the SCI group to help separate them from CHI patients was likely the result of the same factor that led SCI patients to score more impaired on the PAIS-SR Domestic Environment scale. Specifically, the SCI patients were less physically mobile than were the CHI patients. The importance of mobility to three of the six Withdrawal/Retardation items of the KAS-R is obvious. The three physically-oriented items on which the friend/relative was to rate the patient read "Moved about very slowly," "Just sat," and "Would stay in one position for a long period of time." Several informants for SCI patients wrote beside such items comments to the effect that of course this was the case, the person is confined to a wheelchair.

Of perhaps more interest was the last variable entered into the stepwise discriminant function analysis, the PAIS-SR Social Environment score. Poorer scores by CHI patients on this measure of interest and participation in leisure and social activities are consistent with numerous reports (Fordyce et al., 1983; Thomsen, 1974; Weddell et al., 1980) of social isolation and loneliness after CHI. There is at least one very plausible reason for this scale's inclusion in the stepwise discriminant function. The variance associated with physical impairment that in part led to equally poor scores by SCI and CHI patients on the PAIS-SR Social Environment score was taken into the discriminant function by the PAIS-SR Domestic Environment scale and the KAS-R Withdrawal/Retardation scale. The predictive variance that was then left in the PAIS-SR Social Environment score was likely the result of the cognitive and emotional limitations seen after CHI but not SCI.

In conclusion, the results of the exploratory discriminant function analyses suggest that the most visibly obvious difference between CHI and SCI patients is that CHI patients are less physically handicapped than are SCI patients. This lack of an obvious physical handicap post-CHI may lead to less understanding of the plight of the CHI patient and his/her family. The less visible cognitive and emotional limitations of the CHI patient, though, are much more distressing to the CHI patient's family.

<u>Hypothesis three</u>

Hypothesis three stated that there would be a greater drop in socioeconomic status from pre- to post-injury for premorbidly employed CHI patients than for similarly employed SCI patients. This finding was anticipated based on previous research that outlined the deleterious effect of CHI on employment status, and the relatively lesser effect that SCI had on work status.

Hypothesis three was largely supported. There was a strong trend for CHI patients who were employed pre-injury to experience a greater loss in socioeconomic status post-injury than was the case for SCI patients. This finding is consistent with that of Stambrook et al. (1989), whose CHI patients also showed a greater mean loss in socioeconomic status than did SCI patients. However, Stambrook et al. did not statistically analyze their findings. The present findings are also consistent with previous research that showed the rate of return to former levels of employment as being very low after severe CHI, from 5% (Rimel, 1981; Lewin et al., 1979) to

28% (Ackerlund, 1959). The use of socioeconomic status in the present study more clearly delineates the extent of decline of work status after CHI as compared to SCI than does a coarser measure such as return to work.

The greater drop in socioeconomic status after CHI than SCI indicates the extent to which neuropsychological impairment is more deleterious to vocational functioning than is physical impairment. One of the most commonly reported difficulties after any brain injury is a problem with new learning. If the CHI patient has to "re-tool" after head-injury, he/she is far less likely to be able to learn new job skills as readily as the neuropsychologically intact SCI patient.

The cognitively intact SCI patient may perform intellectually demanding sedentary tasks, albeit sometimes with the aid of assistive devices. These tasks cannot generally be mastered by the severely head-injured individual. There are few modifications that can be made in intellectually demanding occupations that do not change the very nature of the occupation itself. For this reason, the jobs obtained by CHI patients would tend to be less intellectually demanding and probably more physically demanding than those obtained by SCI patients. This would be associated with more of a premorbid to post-injury drop in socioeconomic status for the CHI patient than for the SCI patient, as physically-oriented professions tend to have a lower socioeconomic status than do cognitively-oriented professions.

In conclusion, the data analysis associated with hypothesis three indicates that CHI patients experience a greater drop in socioeconomic status than do SCI patients. CHI patients may experience this greater loss, in part because they are less able to perform intellectually demanding jobs than are SCI patients and, in part because they are less able to learn new job skills after their injury.

Hypothesis four

Hypothesis four stated that the correlation between the PAIS-SR Vocational Environment scale and the difference between pre- and post-injury socioeconomic status would be stronger for the SCI group than for the CHI group. This was hypothesized because CHI subjects were thought to be less able to accurately assess the extent to which their injury is associated with their drop in socioeconomic status.

Hypothesis four was weakly supported in that there was only a trend in the hypothesized direction. Nevertheless, the fact that the trend was in the expected direction is consistent with previous findings of CHI patients showing impaired awareness of their limitations

(Weinstein & Lyerly, 1968; Wild et al., 1985). No study to date has utilized the present study's methodology to examine "minimization of deficits" after SCI, but the present findings argue against the same type or degree of lack of admission of deficits after SCI.

The greater awareness of deficits after SCI may in part be the result of the much more visible and obvious physical deficits found after serious SCI. In addition, an intact brain is assessing the deficit areas after SCI whereas a damaged brain is attempting to assess its own limitations after CHI. Society may play a role in reinforcing awareness of deficits after SCI but not CHI. Specifically, observers may more readily acknowledge the obvious physical deficits associated with SCI than the often less visibly obvious cognitive/emotional deficits in the CHI patient. If the CHI patient is less often reminded of his/her handicap than is the SCI patient, he/she is less likely to believe the extent of the deficit that exists.

The trend in the expected direction of reduced awareness after CHI gives control-group methodology support to studies using other methodologies, such as patient-relative discrepancies in ratings of ability to perform daily tasks (Prigatano & Fordyce, 1986). The latter type of study has found that CHI patients report fewer difficulties than relatives report them to have. It would be interesting to include a SCI brain-intact control group in one of these patient-relative studies of ability ratings. This would help to determine if discrepancies found between patient and relative are greater in CHI patients than SCI patients. The information obtained would provide further understanding of the degree to which CHI patients exhibit lack of awareness due to organic factors versus denial due to psychological factors. Specifically, if SCI patient-relative discrepancies were as great as CHI patient-relative discrepancies were, the case for organic factors would be weakened. In contrast, if CHI patient-relative discrepancies far exceeded those of SCI patients and relatives, the case for organic factors would be strengthened.

The fact that the findings of hypothesis four were not more strongly in the expected direction may be a function of the subjective measure of work impairment that was used (i.e., the PAIS-SR Vocational Environment scale). Specifically, none of the questions ask how the injury affected the ability to do the job held prior to the injury. In contrast, the pre-post socioeconomic status measure assesses this objectively. Further, none of the PAIS-SR Vocational Environment items ask how cognitive limitations have affected the ability to work. Such items would probably increase the difference in accuracy between CHI and SCI groups' assessment of their loss of work ability.

In conclusion, the data analyses associated with hypothesis four provide some limited support for the hypothesis that CHI patients less accurately assess their objective loss in work status. Factors such as more visible deficits and a more intact brain likely play a role in more accurate assessment of work limitation after SCI than CHI.

Hypothesis five

Hypothesis five examined the prediction of vocational outcome as measured by the PAIS-SR Vocational Environment scale and the post-injury socioeconomic status score. Hypothesis five consisted of two parts. Part A predicted that PTA duration and the AIR and MMPI scores would contribute significant variance to the prediction of each of the two measures in the CHI group. Education level was not expected to contribute to outcome variance as CHI-related variables were expected to overwhelm the influence of factors that may be relevant in a non-brain injured population. In contrast it was hypothesized that education level, PSI total score, and pre-injury socioeconomic status would contribute significant variance to prediction of the two occupational outcome measures for the SCI group. Level of SCI lesion was not expected to contribute significant variance. The anticipated results for the SCI group were based on previous research that found premorbid factors to be much more strongly related to productive activity than was level of SCI. Part B of hypothesis five will be reiterated after discussion of Part A of hypothesis five has been completed. Because the data analyses associated with Part A of hypothesis five were fairly lengthy, an overview of the results of each regression analysis and their meaning will be provided first. Then, an in-depth examination of the role each variable played in prediction of outcome will conducted.

Only level of premorbid education and AIR score contributed statistically significant amounts of variance to the prediction of current socioeconomic status for the CHI group. PTA duration contributed enough variance to approach statistical significance. These findings indicate that a person with more premorbid education is less likely to end up as economically bad off as one with less premorbid education. In essence, a person with more premorbid education and a higher premorbid socioeconomic status would have to fall further than one with less premorbid education and lower socioeconomic status to end up as poorly off. There is no a priori reason to expect a greater drop in socioeconomic status for the former individual. Nevertheless, the association of injury severity with socioeconomic status indicates that a good premorbid education is only able to partially buffer the effects of a CHI. If the injury is severe enough, the influence of premorbid education will often be diminished.

The existence of a correlation between measures of injury severity and work outcome is consistent with previous research (Bond, 1976; Gilchrist & Wilkinson, 1979; Van Zomeren & Van Den Berg, 1985). However, previous research used coarser measures of work outcome than socioeconomic status. The present findings indicate that injury severity measures are also related to a fine-grained measure of vocational outcome.

Level of premorbid education as a predictor in work outcome after CHI has not previously been extensively examined. The focus has more often been on injury severity measures or on concurrent variables such as emotional problems. The present findings regarding the importance of premorbid education support those of Gjone et al. (1972), who reported that social class was related to outcome. A more extensive premorbid education may provide the CHI patient with more crystallized knowledge to fall back on, resulting in a higher socioeconomic status than that obtained by a lesser educated CHI patient with the same or perhaps even greater injury severity. The better educated CHI patient may also have connections to a more supportive vocational environment post-injury than is available for the less educated, "blue-collar" CHI patient.

The early MMPI scores utilized in the present study neither contributed a statistically significant amount of unique variance nor were correlated with later socioeconomic status. At first glance, such findings are inconsistent with previous research that has found a relationship between work status and psychopathology (Bruckner & Randle, 1972; Gilchrist & Wilkinson, 1979; Stambrook et al., 1988; Weddell et al., 1980). However, previous studies used concurrent rather than predictive designs. In conjunction with the present results, previous findings suggest that personality problems are more useful as predictors of work status the closer in time they are to assessment of work status. This conclusion is supported by the findings of Donaghy (1988) who found that MMPI data obtained at a followup testing were more useful in predicting outcome than were MMPI data from initial testing. A related reason for the poor predictive ability of MMPI scores obtained soon after injury is that the CHI patient may be too impaired to comprehend and respond to test items as adequately as he/she is able to do later in the course of recovery.

For the CHI group, only the AIR score contributed a statistically significant amount of unique variance to the prediction of the PAIS-SR Vocational Environment score. This indicates that the CHI patients say that their work ability is compromised at a level somewhat related to their neuropsychological limitations. This suggests that some severe CHI patients may have at least a limited degree of awareness about the extent of their functional limitations.

The lack of a relationship between premorbid education and subjective assessment of impairment of work ability in the CHI group was expected. This lack of a relationship suggests that level of premorbid education plays little or no role in a CHI patient's subjective assessment of their loss of work ability. Finally, the lack of a relationship between early MMPI scores and later subjective assessment of impairment of work ability may be the result of factors suggested above. Specifically, MMPI data obtained soon after injury may be too temporally removed from long-term outcome to bear the strong relationship to work status that concurrent information on psychopathology bears to work status.

For the SCI patients, the variables that provided a statistically significant amount of unique variance in the prediction of current socioeconomic status were level of SCI lesion and level of premorbid education. Those with lower lesions (i.e., paraplegics) and/or greater premorbid education tended to have a higher socioeconomic status than did those with higher lesions (i.e., quadriplegics) and/or less education. Such results are similar to those found for CHI subjects, where both level of premorbid education and injury severity played some role in prediction of current socioeconomic status. For both CHI and SCI patients it appears that greater premorbid education and associated variables such as a more internal locus of control can aid in favorable long-term socioeconomic outcome. However, injury severity moderates the extent to which premorbid education can buoy long-term socioeconomic status.

The present findings are consistent with previous research (e.g., Bahry-Kozak, 1987; DeVivo & Fine, 1982; DeVivo et al., 1987; Goldberg & Freed, 1982) that has found premorbid variables such as education to be predictive of level of productive activity post-SCI. However, the present findings are at odds with previous research that has found level of SCI lesion to have little or no relationship with participation in productive activity (DeVivo & Fine, 1982; DeVivo et al., 1987; Kemp & Vash, 1981; MacDonald et al., 1987).

There is at least one key reason for the importance of SCI lesion level in the present study and its lack of importance in previous studies. The present study utilized current socioeconomic status as an outcome measure. This measure is largely based on income and occupational prestige. In contrast, previous studies have not weighted income and occupational prestige nearly so heavily in their outcome measures. Instead, they have utilized measures such as amount of time employed post-injury (Goldberg & Freed, 1982) or a composite measure of outcome that includes hobbies, leisure activities, and housework (Bahry-Kozak, 1987; Kemp & Vash, 1971).

In conjunction with previous research, the present results lead to a very logical conclusion. Level of SCI lesion may not be important if one conceptualizes productive activity very broadly and does not differentially weight unpaid or poorly paid activity and well-paid, prestigious activity. In such cases premorbid education level may be important and lesion level may be unimportant as correlates of "how well" one does. However, if income and occupational prestige are heavily weighted in an outcome measure, advantageous premorbid characteristics may not be able to overcome the severe physical limitations associated with a high SCI lesion.

Previous studies that have shown more physically involved SCI patients to be as well off as those who are less physically involved may have been doing the former patients a disservice. Quadriplegics and paraplegics may spend a roughly comparable amount of time engaging in broadly defined "productive activity," but the qualitative characteristics of the activity differ considerably between paraplegics and quadriplegics. Rather than shaping one's outcome measures to show that quadriplegics are doing just as well as paraplegics, showing that quadriplegics are worse off economically could be used to provide impetus for the development of assistive devices and modified environments for quadriplegics. Then it may be possible to legitimately say that quadriplegics are as well off as are paraplegics.

For SCI patients, more premorbid education, higher pre-injury socioeconomic status, and a lower level of SCI were all statistically significant predictors of less impairment on the PAIS-SR Vocational Environment scale. This indicates that SCI patients with more premorbid education, a higher premorbid socioeconomic status, and less physical impairment are less likely to complain of impaired work ability.

These PAIS-SR Vocational Environment results partially support those of previous studies of "productive activity." In the present study advantageous premorbid characteristics were related to subjective impressions of better work ability after injury. Nevertheless, level of SCI lesion was also related to subjective impressions of work ability. Greater levels of physical impairment were related to endorsement of greater difficulty performing work-related activities. The conclusion that may be drawn from these findings is that those who were "better off" premorbidly may be more likely to say that they are able to perform some work now. However, such beliefs are not held regardless of the degree of physical impairment. The degree of physical impairment tempers the degree to which advantageous premorbid characteristics allow one to believe that they are capable of performing a job or other vocational activities.

The second part of hypothesis five stated that the economic disincentive variable would add a statistically significant amount of predictive variance over and above that contributed by the variables in the first part of hypothesis five. This was anticipated because embedded within the economic disincentive score is information as to whether or not the individual is working. However, the score also includes other important information such as sources of income and whether such income would be lost should the person obtain paid employment.

The data analyses associated with the second part of hypothesis five generally supported the hypothesis. The economic disincentive score added between 8% and 18% extra predictive variance over and above that contributed by the variables included in the first part of hypothesis five.

The results associated with the second part of hypothesis five indicate that the possibility of losing pension income upon obtaining paid employment plays some role in preventing both CHI and SCI patients from obtaining employment. If employment were to be obtained, it would likely be of the low-paid variety. This would especially be the case for those with less education and more severe injuries. Employment would often not be economically advantageous in such cases.

The fact that economic disincentive score added predictive variance over and above that obtained using traditional predictors of CHI outcome is a notable finding. The type of disincentive score utilized in the present study does not appear to have been utilized in previous CHI research. Instead, attention has been focused on issues such as the relationship between the amount of a monetary settlement and the time taken for recovery and return to work (e.g., Steadman & Graham, 1969). The finding of a lack of the latter sort of relationship in previous studies is not necessarily at odds with the findings of the importance of economic disincentive in the present study. The purpose of research such as that of Steadman and Graham (1969) was to examine variables associated with obtaining a settlement and whether or not malingering appeared to play a role. In contrast, the present study examined variables associated with return to work once pension or lawsuit settlements had already been obtained. The results of the present and previous research may be summarized as follows. There is little evidence that malingering plays a role in the obtaining of pension or lawsuit settlements. However, once such income is obtained the disincentive of losing it if one obtains low paying employment is enough to prevent some CHI patients from obtaining low-paying employment.

In conclusion, the results of the analyses associated with hypothesis five suggest that for severe CHI patients more premorbid education is associated with a higher socioeconomic status in the long-term post-CHI. This may be because the more educated CHI victim has more premorbidly-obtained knowledge to fall back on than does the less educated CHI victim. However, injury severity moderates the extent to which this relationship may hold true. Scores on personality tests obtained soon after CHI are far less useful as predictors of long-term vocational status than are similar scores obtained several years after injury.

In conjunction with previous research, the present results for SCI patients suggest that premorbid variables such as level of education may be more important than level of SCI is in prediction of the degree of participation in broadly defined "productive activity." However, the degree of physical involvement moderates the extent to which advantageous premorbid characteristics predict involvement in well-paid and prestigious productive activity.

Economic disincentive is of some importance in the prediction of long-term socioeconomic status for both CHI and SCI patients. Loss of pension or other income may dissuade SCI and CHI patients from obtaining employment that may earn them little if any more than they currently receive in pension income. This disincentive may be particularly relevant for those with little premorbid education and/or severe injury. Such individuals are particularly unlikely to earn enough money to make it worthwhile to give up their pensions.

Hypothesis six

Hypothesis six was based on previous research that suggests there are personality score differences between subjects who are "active" agents in their accidents (i.e., are imprudent) and those who are "passive" agents in their accidents (i.e., are non-imprudent).

For the CHI group it was predicted that imprudent subjects would score worse than nonimprudent subjects on the total score of the PSI, higher on scale 4 of the MMPI, lower on scale 5 of the MMPI (if male), and higher on the difference between scales 4 and 3 (i.e., 4 minus 3). These have all been suggested to be measures of "acting out," or poor problem-solving and judgement (Heppner & Peterson, 1988; Graham, 1987). Next, imprudent and nonimprudent CHI subjects were compared to imprudent and nonimprudent SCI subjects on the PSI total score, using a two-way (injury-type by imprudent/nonimprudent) analysis of variance. It was hypothesized that there would be a main effect for imprudent/nonimprudent but not for injury type.

The results of the data analyses associated with hypothesis six were generally not in accord with the hypothesis. Only on the difference between scales 3 and 4 of the MMPI was there a trend for the imprudent CHI subjects to score worse (i.e., higher) than nonimprudent

CHI subjects. There were no differences between imprudent and nonimprudent CHI subjects scores on scales 4 or 5 of the MMPI. Nor was there a main effect for imprudence/nonimprudence on PSI total score across the two groups. There was a trend toward a main effect for injury type, though, with CHI patients scoring worse than SCI patients on the PSI total score.

It is interesting to note that one of the MMPI findings that has been noted previously for imprudent/nonimprudent actions by SCI patients (Fordyce, 1964) was replicated by CHI patients in the present study. High scores on scale 4 of the MMPI are associated with impulsivity and acting out (Graham, 1987). High scores on scale 3 of the MMPI are associated with presence of repressive and suppressive controls (Dahlstrom & Welsh, 1960). When considered together, these two scores were able to differentiate imprudent from nonimprudent pre-injury behavior. Such results indicate that even severe brain injury does not totally wash out presumably premorbid differences in behavior.

The relationship of premorbid behavior to post-injury behavior has received relatively little attention in the past in part because of the difficulty of obtaining unbiased premorbid behavior estimates. Instead, attention has largely focused on the relationship between injury-related factors and post-injury behavior. In conjunction with some previous findings (e.g., Cartlidge & Shaw, 1981), the present results indicate that consideration of pre-accident behavior will result in a better understanding of post-accident behavior. Consideration of pre-accident behavior may prevent ascribing all unusual behaviors seen after CHI to the brain-injury, per se.

The lack of replication of isolated MMPI scale 4 or 5 findings from previous research (Fordyce, 1964) is difficult to explain given the replication of the scale 4 minus scale 3 finding. Perhaps the information added by considering scale 4 in conjunction with scale 3 is necessary to accurately assess acting out behavior in CHI subjects. This interpretation is consistent with comments made by MMPI experts (e.g., Graham, 1987), who state that a richer and more useful description is obtained from interpretation of a combination of MMPI scores than from single scores in isolation.

Another possible reason for the lack of supportive evidence for hypothesis six is that behavior that at first glance appears to be imprudent and impulsive may not always be so. While some individuals may knowingly take risks and end up getting injured, others may instead "stumble" into perilous situations. When risk-takers and others are considered together, any trend towards greater impulsivity on measures such as the MMPI or PSI may be obfuscated. Another reason for the lack of support of hypothesis six may have been that the criteria used to assign patients to imprudent or nonimprudent groups was inadequate. For example, passengers in motor vehicle accidents were designated as nonimprudent in the present study. If such individuals were passengers in a car with a driver that they knew was very intoxicated they may have been better designated as imprudent.

The anticipated main effect for imprudent/non-imprudent behavior on PSI total score was not found. It may have been for the reasons outlined above and/or because the PSI was an inadequate measure for present purposes. Regardless, the unanticipated trend toward a main effect for <u>injury group</u> on the PSI total score deserves some comment. The poorer score by CHI subjects on this measure of day to day problem-solving ability is consistent with previous reports of cognitive impairment and emotional/interpersonal difficulties after brain injury. It is likely that cognitive and emotional/interpersonal difficulties led to this decrement in day to day problem solving ability. One concrete result of difficulty with day to day problem solving activity may be the greater loss in socioeconomic status by CHI than SCI subjects. The day to day problem solving difficulties encountered by CHI subjects are not likely to be solely a continuation of premorbid difficulties, or to be solely the result of living with a chronic disabling condition. Rather, they are probably often due to the neuropsychological limitations brought on by brain-injury.

In conclusion, the results of data analyses associated with hypothesis six suggest that even for the severely head injured, some premorbid behavior differences may be associated with MMPI scores obtained after injury. This underscores the importance of considering premorbid characteristics when attempting to understand post-CHI behavior. Other findings associated with hypothesis six indicate that the day to day problem solving difficulties exhibited by CHI patients are probably not solely the result of having a chronic disabling condition or the result of premorbid differences in problem solving ability. Brain injury does play a large role in the problem solving difficulties of head injured persons. Overall, the findings of hypothesis six indicate that both injury-related and premorbid factors must be taken into account for a more complete understanding of post-injury behavior.

Hypothesis seven

Hypothesis seven simply stated that imprudent subjects would be younger than nonimprudent subjects at the time of their injury. This hypothesis was partially supported as there was a strong trend for imprudent subjects to be younger. This trend supports the findings and interpretation of Fordyce (1964), with SCI patients. Specifically, Fordyce opined that imprudent subjects tend to be younger at injury because if one takes risks, one is likely to suffer a serious injury sooner that if one takes fewer risks.

Conclusions

One of the assumptions underlying the present study was that CHI and SCI patients are premorbidly very similar. This assumption was supported, as the two patient groups matched on a variety of premorbid demographic variables without any special a priori matching procedures being employed. The similarity of the groups allowed inferences to be made about the specific long-term sequelae of brain-injury as opposed to another chronic disabling condition that does not involve the brain.

The CHI patients of the present study had relatives/friends rate them as more impaired than SCI patients on several dimensions commonly reported as problematic after CHI. These difficulties include concentration and memory problems, confusion, and emotional lability. However, several other problems that are commonly noted after CHI were not rated to be present to a degree greater than is found in normals or in SCI patients. These "problems" include anxiety, nervousness, and verbal expansiveness. This suggests that it is not brain injury per se that is responsible for several difficulties commonly reported after CHI. Other factors, such as premorbid characteristics, may contribute to such findings. The importance of considering premorbid factors was indicated by the relationship of pre-injury behavior with at least some post-injury MMPI scores.

Results on the opinion-oriented PAIS-SR warn of the dangers of relying exclusively on CHI patients' views of the nature and degree of their deficits. For example, CHI patients did not report any greater vocational impairment than did SCI patients despite a considerably greater loss of socioeconomic status pre- to post-injury.

The greater loss of socioeconomic status for CHI patients underscores the relatively more disabling effects of cognitive than physical impairment on gainful employment. Difficulty with new learning may, moreso than physical impairment, disrupt one's ability to learn new job-related skills.

Nevertheless, the importance of severe physical limitations should not be underestimated. The degree of physical involvement was associated with long-term vocational status in SCI patients. This finding is at odds with that of previous research. The discrepancy is likely the result of previous research classifying many non-paid or poorly paid activities as "productive." When the latter criteria are employed, premorbid factors such as education are good predictors while degree of physical involvement is not. However, previous research with SCI patients appears to have shaped outcome measures to ensure that quadriplegics "do as well" as paraplegics do. Clearly, this is not the case when job pay and prestige are considered.

As with SCI, both premorbid factors and injury severity are predictors of long-term socioeconomic outcome after severe CHI. Considerable premorbid education may give the CHI patient skills to fall back on at a time when they have difficulty learning new skills. Nevertheless, injury severity moderates the extent to which such skills can be capitalized on. MMPI scores obtained soon after injury are not very good predictors of long-term socioeconomic status. The recovery period is a dynamic time, and later personality scores may be more useful as predictors of outcome than are early ones.

Economic disincentive added considerable variance to the prediction of long-term socioeconomic status over and above the variance contributed by injury severity and premorbid variables. This indicates that many CHI and SCI patients may be reluctant to obtain the low-paying employment they are capable of, lest they lose their pension income. Governments should consider allowing CHI and SCI patients to obtain both pension income and paid employment. Otherwise, a near poverty-level existence may often be unwittingly encouraged.

Future research could elaborate on the present results in several ways. Scales that are designed to assess difficulties found particularly often after CHI would be very useful. The scales used in the present and previous research were designed for other populations and are not optimal for assessment of CHI deficits.

Finer-grained analyses of vocational issues could also be conducted. For example, are individuals with a higher premorbid socioeconomic status more or less likely to return to their previous level than individuals with low premorbid socioeconomic status? In a related vein, it could be asked which factors predict the difference between pre- and post-injury socioeconomic status rather than just post-injury socioeconomic status. Such an analysis addresses itself to an issue that is very relevant to the patient. Namely, what variables predict how the patient will do vis-a-vis his or her own premorbid status?

Overall, the present study has indicated that the long-term adverse effects of CHI often go beyound those associated with SCI. However, not all of the commonly obtained findings with CHI patients are specifically associated with brain injury. Factors such as the presence of a chronic disability and (especially) premorbid characteristics do appear to play a role in some behaviors after CHI. Future studies that employ control groups have considerable potential to further distinguish brain-related disabilities from those due to other factors.

APPENDIX A

LETTERS SENT TO POTENTIAL PARTICIPANTS

I. THE LETTER INTRODUCING THE STUDY TO THE CHI PATIENTS

II. THE LETTER INTRODUCING THE STUDY TO THE SCI PATIENTS

III. THE CHI VICTIM'S LETTER OF CONSENT

IV. THE SCI VICTIM'S LETTER OF CONSENT

V. THE CHI RELATIVE/FRIEND'S LETTER OF CONSENT

VI. THE SCI RELATIVE/FRIEND'S LETTER OF CONSENT

VII. THE CHI VICTIM'S LETTER OF REMINDER

VIII. THE SCI VICTIM'S LETTER OF REMINDER

IX. THE CHI PATIENT'S AND RELATIVE/FRIEND'S LETTER OF THANKS

X. THE SCI PATIENT'S AND RELATIVE/FRIEND'S LETTER OF THANKS

August 9, 1989

Mr. John Smith
100 Smith Street
Smithville, Ontario
A0A 0A0

Dear Mr. Smith:

My name is Chris Paniak. I am a student working under the supervision of Dr. Scott Garner and Dr. Alan Finlayson at Chedoke Hospital in Hamilton. We are now involved in a project that is designed to help us better understand the long-term problems associated with head injury. As a past head injury victim you are in a position to help us in this project, and should you choose to do so, you will be paid for your participation.

When you were a patient at Chedoke you were given some neuropsychological tests. We are interested in studying the relationship between these tests and later ability to perform activities of daily life. We have enclosed three brief questionnaires for you to fill out. One, the PAIS-SR asks questions about the effects that the injury has had on these activities. The PAIS-SR refers to "illness;" please do not be offended by this word, and instead take it to mean "head injury." A second brief questionnaire, the "Background Information Questionnaire," asks questions about your former and current job status, your marital status, and other background information. The third questionnaire, the "Problem Solving Inventory," requires you to indicate how you would go about solving various problems in daily life. For your time, we will send you a cheque for $17.50 upon receipt of these three questionnaires (fully completed), provided that the questionnaire (described below) is also returned fully completed by a close friend or relative of yours. In order to receive payment all materials should be returned within three weeks.

The questionnaire, that the close friend or relative who has most contact with you may complete, is called the "Katz Adjustment Scale." This questionnaire allows us to gain some idea as to the ways in which, if any, your head injury has affected the way those closest to you perceive you. This friend or relative who completes the Katz Adjustment Scale will be mailed a cheque for $7.50 upon receipt of your three fully completed questionnaires and their fully completed questionnaire, if all materials are returned within three weeks.

We have also enclosed (1) a self-addressed and stamped envelope and (2) letters of consent for you and your relative/friend. Would you and your relative/friend please sign the consent forms and return them and the questionnaires within three weeks. If you have any questions please do not hesitate to contact me at the number listed below. There is, of course, strict confidentiality surrounding this project, and you and your friend/relative will remain anonymous.

I thank you and your relative/friend in advance for taking the time to fill out these questionnaires. By participating in this study you may help us to better understand the problems associated with head injury and to better help future head injury victims and their families. Your participation is very valuable and very much appreciated. Thank you again.

Sincerely,

Chris Paniak, M.A.
(416) 521-2100, Extension 7537

Enclosures

August 9, 1989

Mr. John Smith
100 Smith Street
Smithville, Ontario
A0A 0A0

Dear Mr. Smith:

My name is Chris Paniak. I am a student working under the supervision of Dr. Karen Smith and Dr. Alan Finlayson at Chedoke Hospital in Hamilton. We are now involved in a project that is designed to help us better understand the long-term problems associated with spinal cord injury. As a past spinal cord injury victim you are in a position to help us in this project, and should you choose to do so, you will be paid for your participation.

In order to have you help us explore the long-term effects of spinal cord injury, we have enclosed three brief questionnaires for you to fill out. One, the PAIS-SR asks questions about the effects that the injury has had on various activities. The PAIS-SR actually refers to "illness;" please do not be offended by this word, and instead take it to mean "spinal cord injury." A second brief questionnaire, the "Background Information Questionnaire," asks questions about your former and current job status, your marital status, and other background information. The third questionnaire, the "Problem Solving Inventory," requires you to indicate how you would go about solving various problems in daily life. For your time, we will send you a cheque for $17.50 upon receipt of these three questionnaires (fully completed), provided that the questionnaire (described below) is also returned fully completed by a close friend or relative of yours. In order to receive payment all materials should be returned within three weeks.

The questionnaire, that the close friend or relative who has most contact with you may complete, is called the "Katz Adjustment Scale." This measure allows us to gain some idea as to the ways in which others perceive changes, if any, in yourself. This friend or relative who completes the Katz Adjustment Scale will be mailed a cheque for $7.50 upon receipt of your three fully completed questionnaires and their fully completed questionnaire, if all materials are returned within three weeks.

We have also enclosed (1) a self-addressed and stamped envelope and (2) letters of consent for you and your relative/friend. Would you and your relative/friend please sign the consent forms and return them and the questionnaires within three weeks. If you have any questions please do not hesitate to contact me at the number listed below. There is, of course, strict confidentiality surrounding this project and you and your relative/friend will remain anonymous.

I thank you and your relative/friend in advance for taking the time to fill out these questionnaires. By participating in this study you may help us to better understand the problems associated with spinal cord injury and to better help future spinal cord injury victims and their families. Your participation is very valuable and very much appreciated. Thank you again.

Sincerely,

Chris Paniak, M.A.
(416) 521-2100, Extension 7537

Enclosures

HEAD INJURY VICTIM'S CONSENT FORM

I understand that I am being asked to participate in a research project. The aim of the project is to learn more about the abilities of individuals, who have suffered head injury, to perform activities of daily life.

I understand that this project is being conducted by Chris Paniak as part of his Doctoral Dissertation in Clinical Neuropsychology, under the guidance of Dr. Scott Garner and Dr. M. Alan J. Finlayson, Chedoke-McMaster Hospitals.

I understand that participation in this project will involve filling out questionnaires which ask questions about my ability to perform activities in daily life, and about background information such as age, education, and occupation.

I understand that I will be paid $17.50 if my questionnaires and my relative's/friend's questionnaire are all returned, fully answered, within three weeks of mailing.

I understand that I can refuse to participate or can withdraw from the study at any time and, if I do so, it will in no way affect my further care in this hospital.

I have been assured that complete confidentiality will be maintained on all medical records and test scores, and that no names will be published in the research data.

I therefore agree to participate in this study.

____________________	____________________
Name (print)	Date
____________________	____________________
Signature	Address cheque is to be mailed to

Principle Investigator: Chris Paniak, M.A.
Telephone: (416) 521-2100, Extension 7537

SPINAL CORD INJURY VICTIM'S CONSENT FORM

I understand that I am being asked to participate in a research project. The aim of the project is to learn more about the abilities of individuals, who have suffered spinal cord injury, to perform activities of daily life.

I understand that this project is being conducted by Chris Paniak as part of his Doctoral Dissertation in Clinical Neuropsychology, under the guidance of Dr. Karen Smith and Dr. M. Alan J. Finlayson, Chedoke-McMaster Hospitals.

I understand that participation in this project will involve filling out questionnaires which ask questions about my ability to perform activities in daily life, and about background information such as education and occupation.

I understand that I will be paid $17.50 if my questionnaires and my relative's/friend's questionnaire are all returned, fully answered, within three weeks of mailing.

I understand that I can refuse to participate or can withdraw from the study at any time and, if I do so, it will in no way affect my further care in this hospital.

I have been assured that complete confidentiality will be maintained on all medical records and test scores, and that no names will be published in the research data.

I therefore agree to participate in this study.

____________________ Name (print)

____________________ Date

____________________ Signature

____________________ Address cheque is to be mailed to

Principle Investigator: Chris Paniak, M.A.
Telephone: (416) 521-2100, Extension 7537

RELATIVE/FRIEND'S CONSENT FORM

I understand that I am being asked to participate in a research project. The goal of the project is to learn more about the ability of persons, who have suffered head injury, to perform activities of daily life.

I understand that this project is being conducted by Chris Paniak as part of his Doctoral Dissertation in Clinical Neuropsychology, under the guidance of Dr. Scott Garner and Dr. M. Alan J. Finlayson, Chedoke-McMaster Hospitals.

I understand that participation in this project will involve filling out a questionnaire which asks questions about the ability of my relative/friend to perform activities in daily life.

I understand that I will be paid $7.50 if my questionnaire and my relative/friend's questionnaires are all returned, fully answered, within three weeks of mailing.

I understand that I can refuse to participate or can withdraw from the study at any time and, if I do so, it will in no way affect my relative/friend's further care in this hospital.

I have been assured that complete confidentiality will be maintained on all medical records and test scores, and that no names will be published in the research data.

I therefore agree to participate in this study.

______________________________ Name (Please print)

______________________________ Date

______________________________ Signature

______________________________ Address cheque is to be mailed to

Principle Investigator: Chris Paniak, M.A.
Telephone: (416) 521-2100, Extension 7537

RELATIVE/FRIEND'S CONSENT FORM

I understand that I am being asked to participate in a research project. The goal of the project is to learn more about the ability of persons, who have suffered spinal cord injury, to perform activities of daily life.

I understand that this project is being conducted by Chris Paniak as part of his Doctoral Dissertation in Clinical Neuropsychology, under the guidance of Dr. Karen Smith and Dr. M. Alan J. Finlayson, Chedoke-McMaster Hospitals.

I understand that participation in this project will involve filling out a questionnaire which asks questions about the ability of my relative/friend to perform activities in daily life.

I understand that I will be paid $7.50 if my questionnaire and my relative/friend's questionnaires are all returned, fully answered, within three weeks of mailing.

I understand that I can refuse to participate or can withdraw from the study at any time and, if I do so, it will in no way affect my relative/friend's further care in this hospital.

I have been assured that complete confidentiality will be maintained on all medical records and test scores, and that no names will be published in the research data.

I therefore agree to participate in this study.

Name (Please print)	Date
Signature	Address cheque is to be mailed to

Principle Investigator: Chris Paniak, M.A.
Telephone: (416) 521-2100, Extension 7537

Sept. 25, 1989

Mr. John Smith
100 Smith Street
Smithville, Ontario
A0A 0A0

Dear Mr. Smith:

A few weeks ago, I wrote to you on behalf of Dr. Garner, Dr. Finlayson and myself, to request your assistance in our search to better understand the long-term effects of spinal cord injury. We forwarded you four questionnaires and asked that you and the person that you spend the most time with complete them and return them to us.

As of today, I have not received your questionnaires. If you plan to complete the questionnaires, this letter simply serves as a reminder to please do so as soon as possible. If you do not plan to complete the questionnaires, I would appreciate it if you would return the blank questionnaires to me as soon as possible so that I will be aware of you intentions either way.

Once again, we thank you for your time and continue to hope than you will help us in this endeavour.

Sincerely,

Chris Paniak, M.A.

Sept. 25, 1989

Mr. John Smith
100 Smith Street
Smithville, Ontario
A0A 0A0

Dear Mr. Smith:

A few weeks ago, I wrote to you on behalf of Dr. Smith, Dr. Finlayson and myself, to request your assistance in our search to better understand the long-term effects of spinal cord injury. We forwarded you four questionnaires and asked that you and the person that you spend the most time with complete them and return them to us.

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Once again, we thank you for your time and continue to hope than you will help us in this endeavour.

Sincerely,

Chris Paniak, M.A.

Sept. 25 1989

Mr. John Smith
100 Smith Street
Smithville, Ontario
A0A 0A0

Dear Mr. Smith:

On behalf of Dr. Garner, Dr. Finlayson and myself, I would like to thank you for your recent help in our effort to better understand the long-term effects of head injury. Because this is an ongoing project, we do not expect the results to be available for some months. If you are interested in obtaining a short summary of the results, please contact Chedoke in mid-to-late November. A summary should be ready at that time and I will be pleased to forward it to you.

Enclosed you will find payment for your participation. Once again, we thank you for your time and help in this endeavour.

Sincerely,

Chris Paniak, M.A.

Enclosure

Sept. 25, 1989

Mr. John Smith
100 Smith Street
Smithville, Ontario
A0A 0A0

Dear Mr. Smith:

On behalf of Dr. Smith, Dr. Finlayson and myself, I would like to thank you for your recent help in our effort to better understand the long-term effects of spinal cord injury. Because this is an ongoing project, we do not expect the results to be available for some months. If you are interested in obtaining a short summary of the results, please contact Chedoke in mid-to-late November. A summary should be ready at that time and I will be pleased to forward it to you.

Enclosed you will find payment for your participation. Once again, we thank you for your time and help in this endeavour.

Sincerely,

Chris Paniak, M.A.

Enclosure

APPENDIX B

Method Used to Obtain Average Impairment Rating (AIR)

The AIR for each patient was derived from his or her average level of performance on those variables listed below on which he or she was tested. Performance on each test was initially classified into one of five grades (0 to 4). A score of 0 was assigned if performance was more than one standard deviation above the mean of a normal control group (Russell, Neuringer, & Goldstein, 1970) and a score of one was assigned if performance was within the range of plus or minus one standard deviation of the control group. Performances more than one, two, or three standard deviations below the mean of the control group were assigned scores of two three and four respectively. The overall AIR for each patient was then obtained by finding the average of the AIR scores across measures. Even though many of the patients did not have all of the measures listed included in the calculation of their AIR, the entire list is presented for the sake of completeness. The complete set of variables, in alphabetical order, were:

1. Babcock-Levy Story Recall
2. Category Test errors
3. Digit Symbol subtest scaled score, from the WAIS-R
4. Dysgraphesthesia
5. Finger Agnosia
6. Finger tapping (poorest performance, by dominant or nondominant hand)
7. Grip strength (poorest performance, by dominant or nondominant hand)
8. Grooved Pegboard Test (poorest performance by dominant or nondominant hand)
9. H words
10. Seashore Rhythm test
11. Speech Sounds Perception Test
12. Tactual Performance Test (TPT) total time
13. TPT memory
14. TPT location
15. Trails A time
16. Trails B time

APPENDIX C

Measures used

I. Background Information Questionnaire

II. Problem Solving Inventory

III. Katz Adjustment Scale - Relative's Version

IV. Psychosocial Adjustment to Illness Scale - Self Report Version

Background Information Questionnaire

1) What was your marital status at the time of your accident?

__ Single __ Married __ Divorced __ Other

2) What is your marital status now?

__ Single __ Married __ Divorced __ Other

3) How many years of education did you complete before your injury? (Count beginning from grade 1)

______

4) How many years of education have you completed since your accident?

______

5) What did you do for a living before your injury (please be specific; if a student please state the type of program you were in)?

____

6) If you were a student at the time of your injury, what was the occupation of the primary wage-earner (e.g., father or mother) in your family?

____

7) If you are currently doing paid work, please describe the work you do.

____

8) If you are a currently a student please describe the type of program you are in.

____

9) Is your primary role that of a home-maker?

__yes ___no

10) Are you currently unemployed? __Yes __No

11) What is your current mobility status. Do you usually

__ Use an electric wheelchair

__ Use a manual wheelchair

__ Walk with a cane

__ Walk with crutches

__ Walk using a walker

__ Walk completely independently

12) How many people, other than yourself, were financially dependent on you at the time of your injury?

__0 __1 __2 __3 __4 __5 __more than 5

13) How many people, other than yourself, are financially dependent on you now?

__0 __1 __2 __3 __4 __5 __more than 5

14) At the time of your injury, were you

__ Employed full-time

__ Employed part-time

__ in school

__ Unemployed but had worked full time during the two years prior to injury

__ Unemployed but had worked part time during the two years prior to injury

__ had worked some time in the past

-- had never worked

15) What is your present source of income (circle one letter)

A) full time employment plus lawsuit settlement
B) full time employment only
C) part-time employment plus lawsuit settlement
D) part time employment only
E) part-time employment plus disability pension
F) disability insurance settlement plus Canada Pension
G) disability insurance settlement only
H) Workman's compensation pension only
I) Workman's compensation pension plus Canada Pension
J) Canada Pension only
K) Canada Pension plus provincial disability (GAINS-D)
L) Provincial disability (GAINS-D pension only).
M) other (Please specify)

____

16) What amount of money per year would you estimate you would need to earn from employment to make it financially possible for you to discontinue your government or insurance pension? If you are already employed, what is the least amount of money you would accept per year to make employment worthwhile? (Circle one)

A) $15,000 - $19,000
B) $20,000 - $24,000
C) $25,000 - $29,000
D) $30,000 - $34,000
E) $35,000 - $39,000
F) $40,000 or more

17) Have you ever, in any way, been affected by your injury?

___yes ___no

Paniak, Chris - Long-term Psychosocial Outcome after Severe Closed Head Injury

Please do not microfilm Appendix C, pp. 193-208.

Also please note that due to an error in pagination, some of the preliminary pages have not been assigned page numbers.

APPENDIX D

Eggert Scale

Level of Injury	Score
C1 to C3 complete	1
C1 to C3 incomplete or C4 to C5 complete	2
C4 to C5 incomplete or C6 to C7 complete	3
C6 to C7 incomplete or C8 complete	4
C8 incomplete or T1 to T4 complete	5
T1 to T4 incomplete or T5 to T8 complete	6
T5 to T8 incomplete or T9 to T12 complete	7
T9 to T12 incomplete or L1 to L5 complete	8
L1 to L5 incomplete	9

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